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THIRD SERIES FOUNDED BY EDWARD JACKSON

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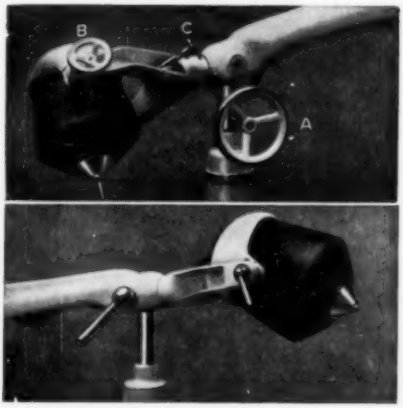

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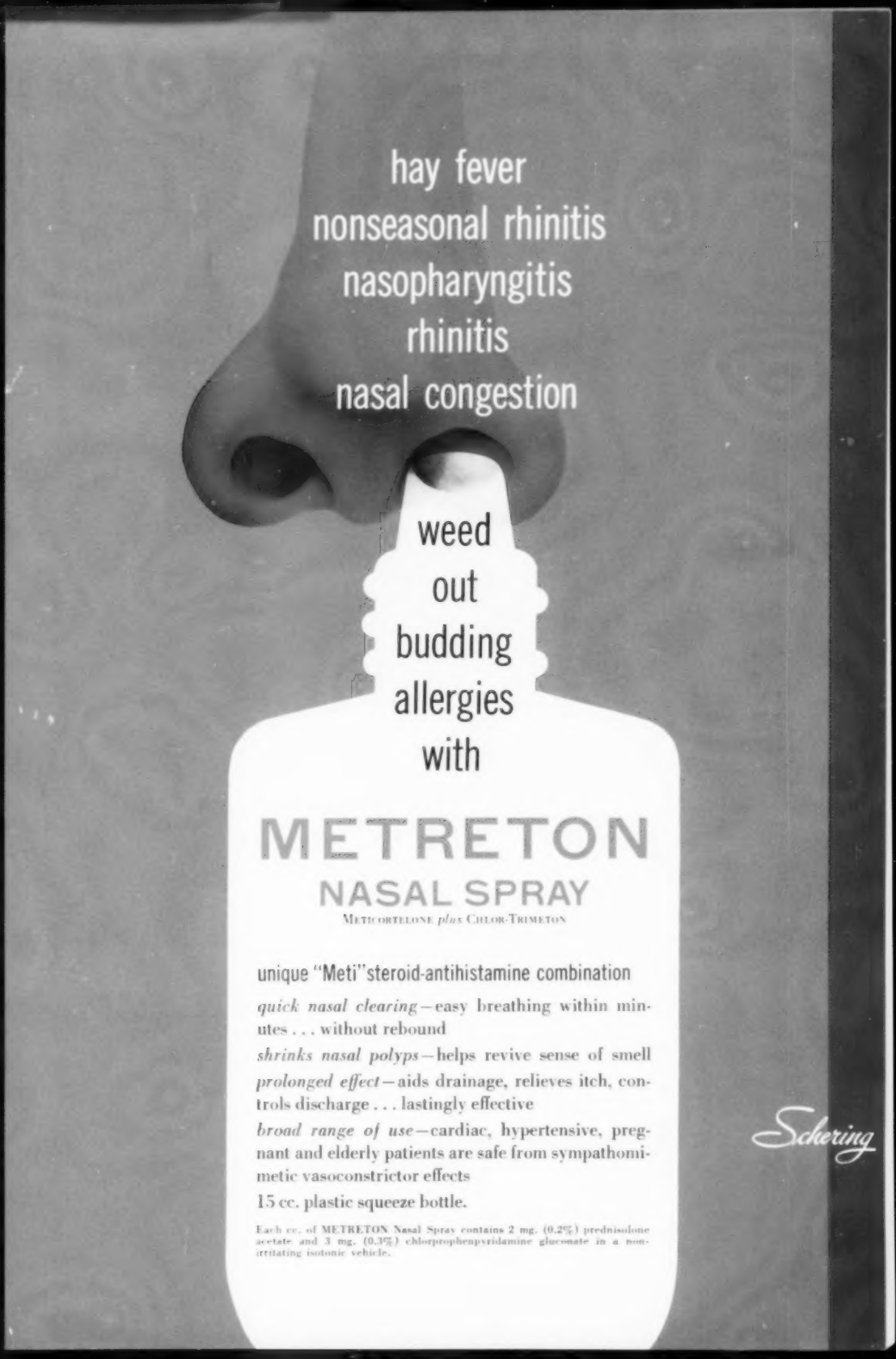
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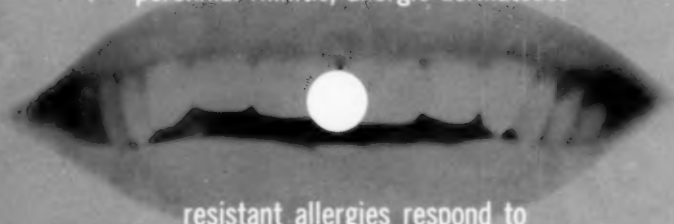

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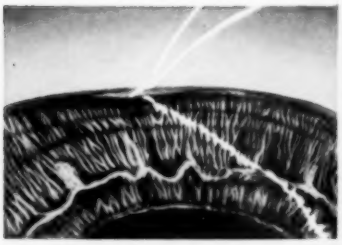

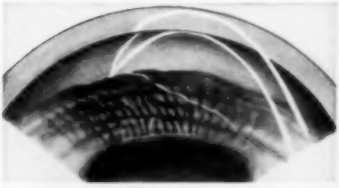

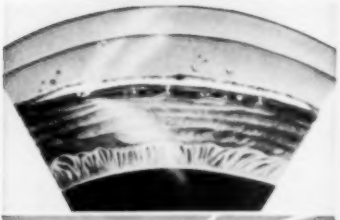

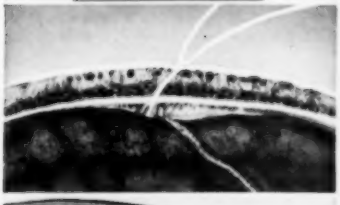

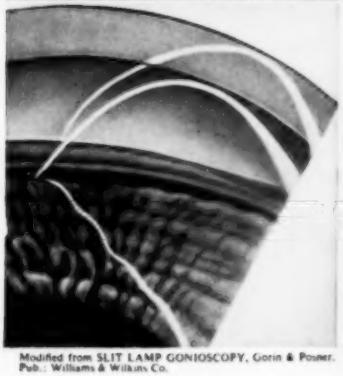

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*Council on Pharmacy and Chemistry: New and Nonofficial Remedies, Philadelphia, J. B. Lippincott Co., 1956, p. 505.

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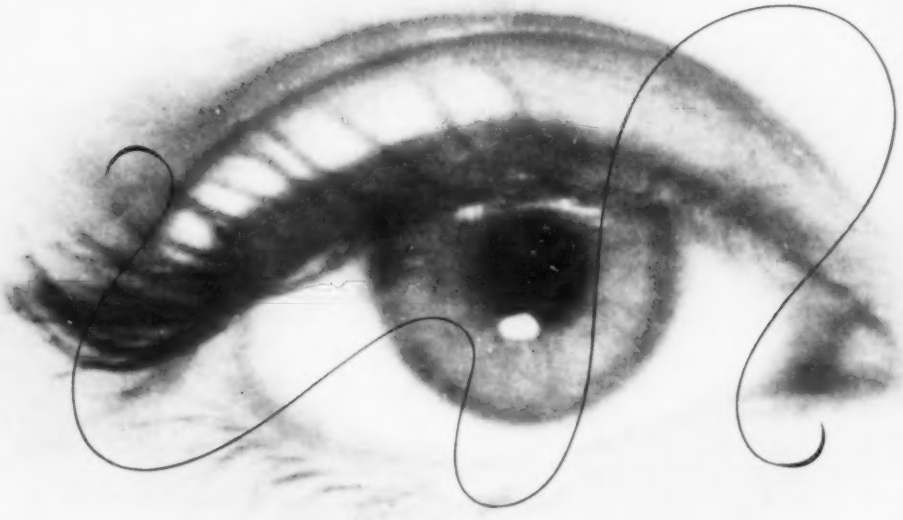

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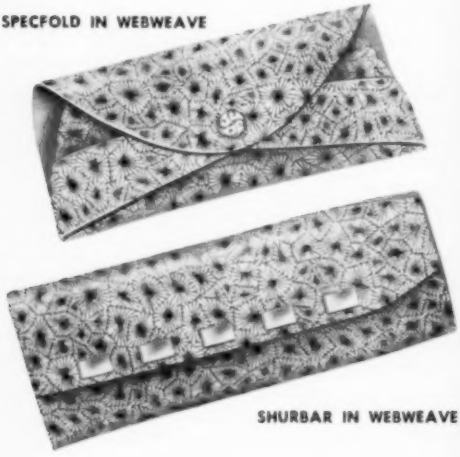

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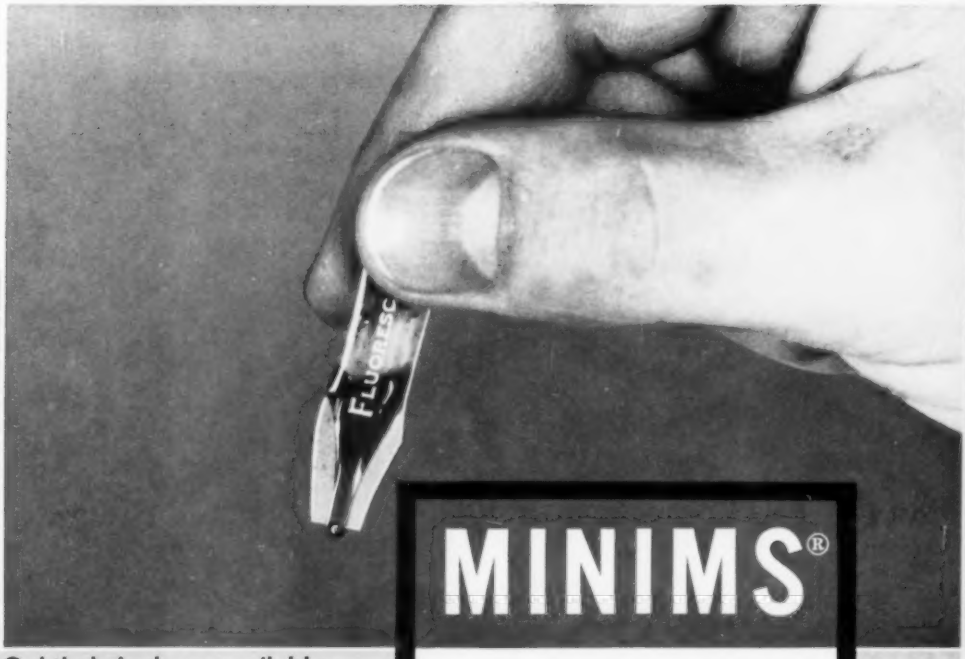

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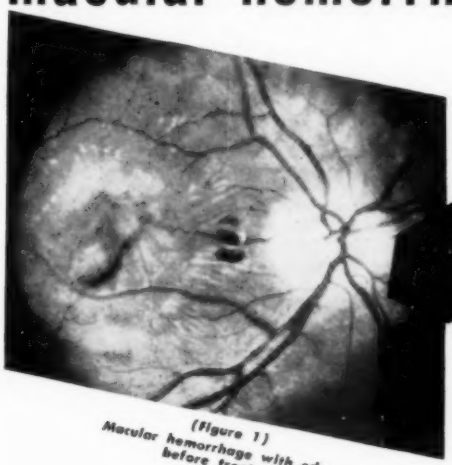
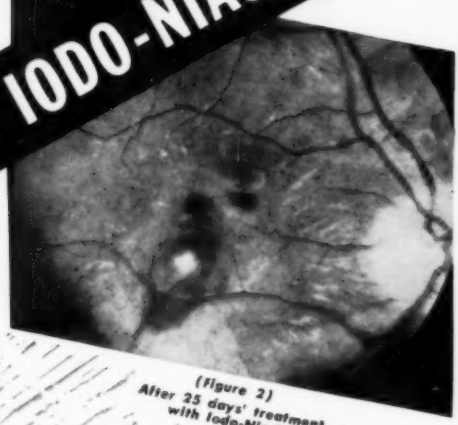


(Figure 1)
Macular hemorrhage with edema, before treatment



(Figure 2)
After 25 days' treatment with Iodo-Niacin

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1. *Am. J. Ophth.* 42:771, 1956.
2. *Am. J. Digest Dis.* 22:5, 1955.
3. *Med. Times* 84:741, 1956.
4. *Cecil's Textbook of Medicine*, 7th ed., 1947, p. 1598.

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AMERICAN JOURNAL OF OPHTHALMOLOGY

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AMERICAN JOURNAL OF OPHTHALMOLOGY

VOLUME 45 JUNE, 1958 NUMBER 6

LONG-TERM PROGNOSIS IN GLAUCOMA SURGERY

PER RIISE, M.D.
Hamar, Norway

Numerous statistics have been published on the results of glaucoma operations. At the last international congress (1954), in surveying these statistics, G. P. Sourdille discussed the different methods of operation and gave the percentage of tension regulation for each method. The statistics also tell about fields of vision kept constant or undergoing relatively small deterioration and about visual acuities that gradually show somewhat more deterioration. In some statistics the time of observation is not stated or, if it is, it covers, in most cases, no more than six months to three years. Even if most glaucoma patients belong to a higher age group, such a short period of observation seems insufficient to ascertain their future fate.

More recent statistics would seem to indicate that, when visual acuity declines after glaucoma operations, the decline is caused by lenticular changes. This indication agrees well with my own observations through the years, and I have the impression that these cases present a special form of cataract whose chief characteristic is swelling of the nucleus, with a gradual but definite tendency to myopia and a relatively slowly declining visual acuity.

The present study of my own material was undertaken to find out whether it would give further information on this question and whether from it could be formed the prospects which might rightly be held out to patients for their more distant future, providing that the operation had successfully regulated the tension of the glaucomatous eye. My first observation was that material of this kind shrinks considerably as soon as it becomes the object of analysis.

Between 1930 and 1956, iridencleisis had been performed on 1,057 eyes with glaucoma simplex, 666 males and 391 females. Since I arbitrarily placed the minimum period of observation at five years, 414 eyes operated on during 1950 through 1956 were excluded from this study. Out of the remaining 636 eyes operated on between 1930 and 1949, only 189 have been under observation for more than five years. The question is inevitable, whether these 189 eyes make up a representative selection or whether these patients came under observation because they had an especially good or an especially bad visual function.

All of my glaucoma patients were requested to come back for observation, at first every quarter, later every half year or year. Unfortunately a great many patients never return after operation; others turn up regularly at the time appointed. But this tells more about the character of the man than of the eye. I have not been able to see any connection between attendance or nonattendance at observation appointments and good or poor function of the operated eye. My intention has been to find out how the eyes have fared that, after operation, have had their tension well regulated.

Of the 190 eyes already mentioned, 38 or 20 percent had, at the last observation or at some other time during the observation period, a tension of more than 30 mm. Hg. In order to include only those eyes in which I was convinced the tension was well regulated, I have omitted all these 38 eyes and, with some hesitation, 15 eyes that had a postoperative tension of between 25 to 30 mm. Hg. Since the fate of these eyes may have

some interest, I have listed them as supplements to the group used for the statistics.

Because the visual field is of great importance when estimating the function of eyes of glaucoma patients, I have also been obliged to omit 37 eyes where perimetric measurement of visual field is lacking either before the operation (because the function was too weak for registration of visual fields) or at the last observation (but then, as a rule, as a result of unsatisfactory examination not as a result of fading function).

There remain for study 100 eyes with convincing regulation of tension, and control of visual fields after more than five years—on an average 8.11 years.

I have divided my material into four groups according to the condition of the visual field immediately before the operation, as this seems to be of importance to the further development of the disease. The visual field is based on an estimated comparison with normal visual fields. I have not been able to estimate in figures the valuable findings of Bjerrum's scotoma.

Group I

Group I includes eyes in which the tension is favorably regulated and which, before operation, had unrestricted visual fields. Tension immediately before it was controlled was, on an average, 43 mm. Hg with pilocarpine, at the last examination—an average of 19.4 mm. Hg without miotics. The time of observation for this group averaged 8.6 years. The group was comprised of 31 eyes.

Visual fields

During the course of time of observation the visual fields of this group decreased from 1.0 to 0.94 percent of a complete visual field. A moderate loss of visual field was registered in eight out of 31 eyes (1, 3, 4, 6, 9, 11, 13, 20). Loss of visual field in three of these eyes (3, 11, 20) was perhaps partly or wholly due to increase of refraction and decrease of visual acuity as a result of swelling of the lens nucleus.

Visual acuity

Within the same time the visual acuity of this group had decreased on an average from 0.73 to 0.54 and nine out of the 31 eyes had a loss of visual acuity of at least two lines on the Snellen chart (1, 2, 3, 8, 9, 11, 20, 25, 28).

Increase of refraction

During the observation period, an increase of refraction of more than one diopter, on an average 4.5 diopters, was recorded in 11 eyes (1, 2, 3, 13, 16, 18, 20, 23, 25, 26, 28). In seven of these (1, 2, 3, 13, 20, 23, 25) opacities of the lens were recorded. During the observation period, a cataractous lens was extracted from one eye (30). Of the nine eyes with loss of at least two lines in visual acuity, six had an increase of refraction of more than one diopter.

Summary for Group I

Eyes with unrestricted visual fields at the time of operation seem to have favorable prospects for preservation of the visual fields for a period of nine years. The average loss in this series was six percent of the normal visual field.

As to preservation of visual acuity the prospects are not so good; half of the eyes studied showed a decrease of visual acuity which, to a great extent, seems to be due to sclerosis of the nucleus of the lens, with a strong tendency to myopia.

All 31 eyes had, after 8.6 years, usable visual function. And what is quite important is that the cause underlying most of the loss in visual acuity was curable.

Group II

Group II includes the eyes that, immediately before operation, had restricted visual fields, but the fields were less than 50 percent impaired.

Tension before operation averaged 44 mm. Hg; at the most recent postoperative examination, 16 mm. Hg, on an average. Time of observation after operation averages 7.3 years. The group includes 30 eyes.

TABLE 1A

GROUP I: GLAUCOMATOUS EYES WITH UNRESTRICTED VISUAL FIELDS BEFORE OPERATION. POSTOPERATIVE TENSION NOT ABOVE 25 MM. HG

No.	Name	Eye	Tension		Refraction	Vision	Visual Fields	Encleisis	Date Last Examination	Years Since Operation	Filtration	Tension		Refraction	Visual Acuity	Visual Fields	Lens Opacities	Other Eye
			Without Miotics (mm. Hg)	With Miotics								Without Miotics (mm. Hg)	With Miotics					
1	T. O.	S	77	49	+2.0	6/6	1	7/29/35	4/17/52	16.5	+	22		E	1/62−	3/4	+	Encleisis 1950
2	S. A.	S		55	E	6/6	1	3/11/36	10/31/50	14.5	+	12		−3.5	6/12	1	+	Encleisis (No. 18)
3	S. A.	D	54	54	E	6/9	1	5/11/36	12/ 7/55	19.5	+	24		−10.0	6/36	4/5	+	Encleisis (No. 87)
4	G. M.	D	48	48	+1.0	6/6	1	6/25/36	1/17/52	15.5	+	14		+2.0	6/9	4/5	Traces	Glaucoma absolutum
5	F. K.	S	68	68	−1, −2, 90°	6/18	1	2/22/37	9/26/47	10.5	+	19		−1.5	6/18	1	+	Encleisis (No. 9)
6	A. O.	D		41		6/9	1	6/14/39	8/28/51	12.0	+	23			6/9−	4/5		Operated elsewhere 1938
7	F. A.	D	48	43		6/12	1	8/20/40	1/26/46	5.5	+	22		−1.0	6/9+	1	+	Glaucoma absolutum
8	A. K.	D	58	58	+0.5	6/9	1	10/18/40	10/18/48	8.0	+	25		−0.5	6/18	1	+	Encleisis 1931
9	F. K.	D		47	E	6/12+	1	11/ 5/40	9/30/53	12.5	+	22		−1.0	6/60	4/5		Encleisis (No. 5)
10	P. E.	S		41		6/9	1	11/24/41	6/13/52	10.5	+	22		−0.5, −1, 10°	6/12	1	Traces	Encleisis (No. 154)
11	F. G.	S	58	45	−2.0	6/6−3	1	12/ 9/42	10/11/50	8.0	+	8		−2.5	6/24+	3/4	+	Encleisis (No. 46)
12	H. J.	D	35	32		6/6−	1	12/10/42	10/11/48	6.0	+	5		+1.5	6/9	1	Traces	Encleisis (No. 62)
13	M. O.	D	55	55	E	6/12	1	4/29/42	5/ 8/51	9.0	+	19		−1.5	6/18	1/2+	+	Encleisis (No. 63)
14	K. K.	S	38	34		6/6	1	12/ 2/43	11/13/51	8.0	+	22		+1.0	6/6	1		Encleisis (No. 134)
15	B. B.	D	33	33		6/6−	1	10/20/43	6/27/49	5.5	+	15			6/6+	1		Encleisis (No. 64)
16	E. G.	S	90	48	+0.75	6/6	1	9/30/43	1/ 6/54	10.0	+	24		−0.5, −0.5, 90°	6/9−	1		Glaucoma absolutum
17	E. O.	S	42	45	+1.5	6/18	1	1/24/44	6/12/51	7.5	+	14		+2.0	6/12−	1		Encleisis 1951
18	S. A.	D		41	−0.5	6/6	1	6/13/44	10/31/50	6.0	+	17		−3.0	6/6−3	1		Encleisis (No. 2)
19	B. E.	S	35	33	−3.0	6/6−	1	10/ 9/45	12/15/52	7.0	+	22		−2.0	6/9+	1		Encleisis (No. 21)
20	T. M.	D		52	+1.0	6/9	1	11/23/45	6/21/53	7.5	+	17		−7, −1, 150°	6/36	4/5	+	Glaucoma absolutum
21	B. E.	D	41	33	−3.5	6/12	1	3/20/46	4/15/53	7.0	+	23		−3.0	6/12−	1		Encleisis (No. 19)
22	F. T.	S	35	40	−0.5	6/6	1	8/ 8/47	12/11/52	5.0	+	24		−0.5	6/6−	1	Traces	Glaucoma incipiens
23	H. M.	S		38	+3.0	6/12−	1	6/20/47	9/19/52	5.0	+	18		−5.0	6/18	1	+	Normal
24	H. I.	S		35	−0.5, −2, 135°	6/9	1	4/29/47	3/10/53	5.5	+	23		−2, −1, 15°	6/12−	1	+	Encleisis (No. 73)
25	N. O.	D	45	45	0+0.5	6/6	1	12/ 9/47	10/ 1/53	6.0	+	15		−6.0	6/24+	1	+	Encleisis (No. 170)
26	S. H.	D	35	35	0−1−2	6/18	1	2/10/47	1/30/53	6.0	+	17		−3, −1.5, 0°	6/24+	1		Normal
27	S. P.	S	38	34	+0.5, +0.5, 0°	6/6	1	11/14/47	2/13/53	5.0	+	17			6/6	1		Encleisis (No. 45)
28	W. O.	D		38	+2.0	6/6	1	5/27/46	5/ 5/54	8.0	+	14		−3, −1, 140°	6/18+	1		Encleisis (No. 61)
29	O. O.	D		43	+2.0	6/18	1	5/ 6/49	12/ 5/55	6.5	+	19		+2, +0.5, 0°	6/12	1		Encleisis (No. 179)
30	H. S.	S	45	35		4/60	3/4	10/21/46 3/15/51 cat. extr. intracap.	11/28/55	9.0	+	20		+10, +3, 150°	6/6	1		Cataract+glaucoma
31	S. G.	D		33	+1.0	6/6	1	1/31/49	4/26/55	6.0	+	24		−0.75, 90°	6/9+	1		Normal
Average				43		0.73	1.0			8.6		19.4			0.54	0.94		

TABLE 1B

CASES BELONGING TO GROUP I BUT OMITTED FROM STUDY BECAUSE VISUAL FIELDS WERE NOT TAKEN AT LAST EXAMINATION

No.	Name	Eye	Tension Without Miotics (mm. Hg)	Tension With Miotics (mm. Hg)	Refraction	Visual Acuity	Visual Fields	Iridencleisis	Date Last Examination	Years Since Operation	Filtration	Tension Without Miotics (mm. Hg)	Tension With Miotics (mm. Hg)	Refraction	Visual Acuity	Visual Fields	Lens Opacities	Other Eye
32	J. K.	S		57	−0.5	6/9	1	1/ 2/40	5/29/47	7.0	+	26		−1, −1.5, 90°	6/12−			Encleisis (No. 49)
33	N. A.	S	68	43	−0.5, +1, 0°	6/9	1	10/20/37	12/21/44	7.0	+	20		−0.5, +1.5, 0°	6/9−	Donders good field		Encleisis (No. 148)
34	N. E.	D		58		6/9	1−	2/17/39	2/18/47	8.5	+	12		+2, 0°	6/12			Encleisis (No. 164)
35	P. P.	D		48	E	6/9	1	10/22/40	6/15/46	5.5	+	15		−4, −1.5, 90°	6/9			Encleisis (No. 91)
36	B. G.	D	58	41	+3.5, −1.5, 90°	6/9	1	3/21/41	7/ 4/49	8.0	+	9		+1, +1.5, 0°	6/18		+	Glaucoma absolute
37	L. M.	D		50	−2.0	6/36	1	4/21/42	6/19/48	5.0	+	13		−7.0	6/24	Donders good field		Glaucoma absolute
38	F. E.	D	48	48	−1.0	6/18	1	1/12/39	6/ 1/44	5.5	?		22		4/60		+	Encleisis 1944
39	K. O.	S		40	−0.5, −0.5, 0°	6/12	1	8/15/49	9/16/54	5.0	+	22			H. M.		Mature cataract	Normal
Average				48		0.54				6.4					0.36			

TABLE 1C

CASES BELONGING TO GROUP I BUT OMITTED FROM STUDY BECAUSE POSTOPERATIVE TENSION RANGED BETWEEN 25 TO 30 MM. HG

No.	Name	Eye	Tension Without Miotics (mm. Hg)	Tension With Miotics (mm. Hg)	Refraction	Visual Acuity	Visual Fields	Iridencleisis	Date Last Examination	Years Since Operation	Filtration	Tension Without Miotics (mm. Hg)	Tension With Miotics (mm. Hg)	Refraction	Visual Acuity	Visual Fields	Lens Opacities	Other Eye
40	E. E.	S		35		6/6	1	3/14/47	5/ 6/53	6.0	+	28			6/6	1		Normal
41	F. O.	D		35	−0.75	6/12+	1	11/ 6/47	9/ 2/52	5.5			25	−5, −1, 170°	6/36	1	+	Normal
42	L. O.	D		32	E			6/19/47	12/11/52	5.5	+	26			6/6	1		Encleisis (No. 77)
43	N. O.	D	38	37	+3, +2.5, 90°	6/12	1	3/ 8/47	6/10/53	6.0	+		30	+3.5, +2.5, 90°	6/9−	1		Encleisis (No. 184)
44	S. O.	D		35	−1.5	6/9+	1	5/14/48	11/ 9/55	7.5	+		28	−5.0	6/24	4/3		Glaucoma incipiens
45	S. P.	D	34	35	+1.5, 0°	6/6	1	11/11/47	2/13/53	5.0	+		28		6/6	1−		Encleisis (No. 27)
Average				35		0.79				5.9					0.67	0.96		

TABLE 1D

CASES BELONGING TO GROUP I BUT OMITTED FROM STUDY BECAUSE POSTOPERATIVE TENSION WAS ABOVE 30 MM. HG (EYES NOT REOPERATED)

No.	Name	Eye	Tension		Refraction	Visual Acuity	Visual Fields	Iridencleises	Date Last Examination	Years Since Operation	Filtration	Tension		Refraction	Visual Acuity	Visual Fields	Lens Opacities	Other Eye
			Without Miotics (mm. Hg)	With Miotics								Without Miotics (mm. Hg)	With Miotics					
46	F. G.	D	43	30	E	6/6		3/31/43	2/26/52	8.5	+	35		−2, −1.5, 0°	6/18	1−	+	Encleisis (No. 11)
47	G. M.	S		35	+2.5	6/24	1	10/3/47	4/22/53	5.5	Dub.	32		+1, 90°	6/18	4/5		Encleisis 1948
48	S. A.	S		40	+0.5, 90°	6/6	1	11/22/49	3/9/56	6.0	−	25/30		−1, −1, 20°	6/9	1		Glaucoma incipiens
49	J. K.	D	67	48		6/18	1	1/26/35	5/29/47	12.0	+	32			H. M.	temp.		Encleisis (No. 38)
Average				38		0.65				8					0.33	0.69		

TABLE 1E

CASES BELONGING TO GROUP I BUT OMITTED FROM STUDY BECAUSE POSTOPERATIVE TENSION WAS ABOVE 30 MM. HG (EYES REOPERATED)

No.	Name	Eye	Tension		Refraction	Visual Acuity	Visual Fields	Iridencleisis	Tension With Miotics (mm. Hg)	Reoperation	Tension With Miotics (mm. Hg)	Reoperation	Tension (mm. Hg)	Operation	Date Last Examination	Years Since First Examination	Filtration	Tension		Refraction	Visual Acuity	Visual Fields	Lens Opacities	Other Eye
			Without Miotics (mm. Hg)	With Miotics														Without Miotics (mm. Hg)	With Miotics					
50	R. E.	D		48		6/18	1	1/14/44	35	5/16/51 Encleisis					11/12/52	8.5		15		+2, +1, 0°	6/24	1/4		Encleisis 1949
51	M. O.	D	58	58	−5.0	6/9		11/14/45	41	−/6/46 Encleisis	52	9/1/50 Cyclodial.	11	11/11/50 Intracap.	6/20/52	6.5		19		+10, +1, 0°	6/6−	4/5		Normal
52	J. M.	D		55	+2.5	6/9	1	5/7/46	40	10/11/46 Encleisis					6/10/53	7.0	+		25	+3.0	6/60	1	+	Encleisis (No. 180)
53	S. K.	D	43	43	−0.75	6/9	1	6/9/39	45	6/29/45 Encleisis					9/19/45	6.0			26	−2.0	6/24	3/4		Glaucoma absolute
54	S. B.	S	38	33	−1.0	6/12	1	10/1/46	33	2/9/48 Encleisis	38	2/18/49 Cyclodial.	11	11/21/50 Intracap.	9/4/51	5.0		Soft		+12, +2, 160°	6/6	Not recorded		Encleisis (No. 151)
55	N. K.	S	35	35	E	6/18	1	5/27/47	43	5/13/48 Cyclodial.					3/17/52	5.0	−	45		−2.0	6/24	1		Encleisis 1951
56	S. K.	D	38	32	−0.5	6/24	1	9/10/47	34	6/13/51 Cyclodial.	15			10/13/52 Intracap.	2/9/53	5.0	−	11		+12, +4, 10°	6/60	2/3		Glaucoma incipiens
57	V. O.	S	35	35	+1.0	6/6	1	4/10/47	35	1/20/50 Encleisis					8/10/53	5.5		22		+1.0	6/18	1		Glaucoma incipiens
Average				42				0.72										23			0.40	0.78		

Visual fields

During the course of observation time, the average decrease in the visual fields of this group was from 0.73 to 0.65, that is, eight percent of a complete visual field. A loss of visual field was registered in 11 out of the 31 eyes. In three of these (61, 70, 79) the loss of visual field may have some connection with sclerosis of the lens nucleus with a pronounced tendency to myopia and decrease of visual acuity.

Visual acuity

Visual acuity had, during the time of observation, decreased from 0.59 to 0.40. A loss of visual acuity could be registered in 16 of the eyes and more than two lines on Snellen's chart in eight (59, 60, 61, 62, 65, 70, 75, 79).

Increase of refraction

In 11 eyes (59, 60, 61, 63, 70, 71, 73, 75, 79, 83, 84), an average of more than four diopters of myopia developed during the time of observation. In eight of these eyes, opacities of the lens were observed.

In one of the eight eyes with loss of visual acuity of more than two lines on Snellen's chart, this loss was caused by degeneration of the macula (65).

Six of the remaining seven eyes showed an increase in refraction (59, 60, 61, 70, 75, 79), and in six of the eyes with loss of visual acuity, opacities of the lens have been noted. At the most recent examination, three eyes (60, 64, 65) had visual acuity of below 6/60. In one among them degeneration of the macula was the cause. Two out of 30 had visual fields about one third of normal (67, 70); 28 had visual fields of at least one half.

Summary for Group II

For two eyes that, before operation, had restricted visual fields, but more than half of visual field was unimpaired, the prospects of preservation of visual fields seemed rather good for a period of about seven and one-half years (the average loss was about eight percent of the normal visual field).

In Group II as in Group I, the loss of visual acuity is more marked than the loss of visual field. The most important cause for this seems to be sclerosis of the lens nucleus, with a tendency to myopia. The average tension at the last observation of the group with increase of refraction did not vary much from the average of the whole group.

All eyes had, at the last examination, usable eyesight.

Group III

This group comprises eyes that immediately before operation had visual fields restricted to between one fourth to one half of normal. The preoperative tension of this group averaged 45 mm. Hg; at the most recent postoperative examinations, 17.6 mm. Hg. The time of observation after operation averaged 8.6 years. There were 26 eyes in the group.

Visual fields

During the time of observation, the visual fields of this group decreased on an average, from 0.4 to 0.19, that is, a loss of 21 percent of the normal visual field. Only five out of 26 (131, 136, 141, 145, 146) had no or only insignificant loss of visual field.

Visual acuity

The average decrease of visual acuity during the time of observation was from 0.38 to 0.20. Eight of these 26 eyes (134, 135, 136, 137, 139, 141, 145, 147) had unchanged or improved visual acuity. Of 18 eyes with loss of visual acuity, 10 had retained acuity of more than 6/60 (126, 128, 130, 131, 132, 133, 138, 140, 143, 146); three before operation already had a visual acuity of less than 6/60.

Increase of refraction

On eight eyes with visual acuity of finger counting or less, no notes have been made

TABLE 2A

GROUP II: GLAUCOMATOUS EYES WITH VISUAL FIELDS BEFORE OPERATION PLUS ONE HALF TO MINUS ONE. POSTOPERATIVE TENSION NOT ABOVE 25 MM. HG

No.	Name	Eye	Tension		Refraction	Visual Acuity	Visual Fields	Iridencleisis	Date Last Examination	Years Since Operation	Filtration	Tension		Refraction	Visual Acuity	Visual Fields	Lens Opacities	Other Eye
			Without Miotics (mm. Hg)	With Miotics								Without Miotics (mm. Hg)	With Miotics					
58	G. K.	D	45	35	+0.75	6/6	3/4	10/30/32	1942	10.0	+	17			6/9	1/2		Encleisis 1939
59	S. G.	D	90	60	+1.0	6/6	4/5	11/21/32	9/ 7/43	10.5	+	25		−1, −1.5, 105°	6/18	2/3		Encleisis (No. 122)
60	B. A.	D	48	43	+2.0	6/9	1/2+	2/11/40	5/21/46	6.0	+	12		−3.5, 105°	3/60	1/2−	+	Normal
61	W. O.	S	48	48	+2.0	6/9	3/4	2/28/40	5/ 5/54	14.0	+	15		−6, −2, 70°	6/36	1/2	+	Encleisis (No. 28)
62	H. J.	S	38	35		6/6−	3/4	11/30/42	2/15/50	7.0	+	5.0		+1.5	6/18	3/4	+	Encleisis (No. 12)
63	M. O.	S	48	46	+1, 165°	6/18	4/5	5/ 1/42	5/ 8/51	9.0	+	19		−1.5	6/18	1/2+	+	Encleisis (No. 13)
64	B. B.	S	58	45		2/60	2/3	10/20/43	6/27/49	5.5	+	25			2/60−	2/3−		Encleisis (No. 15)
65	G. O.	D	48	48		6/12	2/3	3/ 1/43	6/25/48	5.0		15		Macular degeneration	2/60	2/3		Normal
66	T. I.	D	35	35		6/60	2/3	3/24/43	12/ 8/51	8.0	+	24		−1.0	6/60	2/3		Glaucoma incipiens
67	D. K.	S		59		6/24	3/4	2/14/44	11/13/52	8.5	+	15		−2, +4, 15°	6/36	1/3	+	Encleisis (No. 177)
68	G. E.	S		48		6/12	3/4	1/24/44	4/22/54	10.0	+	13		−1, 40°	6/12	3/4	Traces	Encleisis (No. 69)
69	G. E.	D		43		6/9	3/4	1/31/44	4/22/54	10.0	+	12		+0.5	6/9	3/4−		Encleisis (No. 68)
70	S. K.	D	90	78	+1.0	6/9+	3/4	6/14/45	3/ 6/52	6.5	+	20		−9.0	6/24	1/3	+	Encleisis (No. 185)
71	N. T.	D	68	45	−1.0	6/24	3/4	3/ 6/45	11/ 2/52	7.5	+	25		−3.0	6/9−	3/4		Glaucoma incipiens
72	S. L.	D		45		6/9	4/5	11/23/45	7/15/52	6.5	+	15		−0.75	6/9	4/5		Encleisis (No. 95)
73	H. I.	D	58	52	−1, −1.5, 15°	6/18	2/3	3/24/47	3/10/53	6.0	+	22		−3, 1.5, 15°	6/24−	2/3	+	Encleisis (No. 24)
74	B. E.	S	56	58	+0.5	6/9	2/3	11/19/45	3/ 4/55	9.5	+	22			6/9−	2/3		Encleisis (No. 81)
75	K. M.	D	35	35	+1.0	6/6−	4/5	2/ 3/47	2/19/53	6.0	+	15		−0.75	6/18+	2/3	+	Encleisis 1951
76	L. K.	S	47	35	+1.5	6/6	3/4	2/14/47	12/ 4/52	5.5	+		19	+1.0	6/12	1/2		Encleisis (No. 142)
77	L. O.	S	40	35		6/6	4/5	4/10/47	12/11/52	5.5	+	15		+0.75, 45°	6/6−3	1		Encleisis (No. 42)
78	M. M.	S		35	+2.5	6/9−	4/5	2/11/47	6/17/53	6.0	+	17		+3.0	6/9	4/5	Traces	Encleisis 1947
79	S. O.	S		42	−1.0	6/12	2/3	9/ 5/47	12/16/52	5.0	+	19		−5.0	6/60	1/2	+	Encleisis (No. 101)
80	T. J.	D	55	35	+1.5	6/9+	2/3	1/13/47	10/ 7/54	7.5	+	19		+1.5	6/9	1/2+		Cataract incipiens mature, glaucoma
81	B. E.	D		43	+1.0	6/9	4/5	11/17/48	3/ 4/55	6.5	+	19			6/9	4/5		Encleisis (No. 74)
82	M. M.	D	55	55	−0.75, 10°	6/9−	3/4	10/ 1/48	1/27/54	5.0	+	15		−1.0	6/6−2	3/4		Glaucoma incipiens 1952
83	N. J.	S		35		5/60	1/2+	8/18/48	8/ 9/54	6.0	+	18		−5.0	6/60	1/2+		Glaucoma incipiens
84	A. O.	D		34	−0.75	6/12−	4/5	3/10/48	10/28/54	6.5	+	15		−2.5, −1, 90°	6/24+	4/5	+	Normal
85	K. O.	S		37		6/18	3/4	9/ 7/49	4/18/56	6.5		25			6/24+	3/4		Normal
86	J. T.	S		34	−3, −1, 90°	6/6	4/5	2/ 9/48	10/19/54	6.5	+	13		−3.5, 0.75, 90°	6/9	4/5−		Encleisis (No. 113)
87	S. A.	S	59	36	−2.0	6/12+	3/4	4/ 9/49	12/ 7/55	6.5	+	5.0		−2.0	6/18	3/4		Encleisis (No. 3)
Average				44		3.59	0.73			7.3		16			0.4	0.65		

TABLE 2B

CASES BELONGING TO GROUP II OMITTED FROM STUDY BECAUSE VISUAL FIELDS WERE NOT TAKEN AT LAST EXAMINATION

No.	Name	Eye	Tension		Refraction	Visual Acuity	Visual Fields	Iridencleisis	Date Last Examination	Years Since Operation	Filtration	Tension		Refraction	Visual Acuity	Visual Fields	Lens Opacities	Other Eye
			Without Miotics (mm. Hg)	With Miotics								Without Miotics (mm. Hg)	With Miotics					
88	S. M.	S	58	48	+7.0	6/9−	4/5	3/13/31		8.0		17		+6	6/9			Glaucoma incipiens
89	H. O.	S	58	45		6/12	2/3	1/18/34		5.5		5			6/24		Macular degeneration	Encleisis (No. 174)
90	M. A.	S	43	43		6/9	3/4	11/21/39	9/ 1/49	9.5	+	13			6/60−		+	Glaucoma absolute
91	P. P.	S	65	48	+1.5, 0°	6/9	3/4	3/22/39	6/15/48	9.0		15		−6, −2, 90°	6/18		+	Encleisis (No. 35)
92	P. K.	D		48	+1.0	6/9	3/4	6/17/41	6/22/51	10.0		19		+1.0	6/12−		+	Encleisis (No. 129)
93	T. A.	S	68	48	+1.5, +1, 20°	6/12	3/4	4/28/41	4/22/48	7.0	+	8		−2, −1.25, 90°	6/60−		+	Normal
94	R. S.	S	65	48		6/6	3/4	1/19/42	9/12/47	5.5	+	26		+0.5, +1.5, 0°	6/12			Normal
95	S. L.	S	40	40		F.C.	3/4	11/ 4/48	9/ 9/54	5.5	+	17		F.C. 2 m		Not recorded	++	Encleisis (No. 72)
96	S. J.	S		40	−0.75, 90°	6/6−3	4/5	10/ 6/49	3/19/56	6.5	+	12		−0.5, −1.5, 90°	6/12			Cataract extract.
97	R. E.	S		59	+1.5	6/24+	3/4+	11/18/49	9/ 7/55	6.0	+	13		+1.5	6/24+			Encleisis 1944
98	M. S.	S	72	40	+1, 0°	6/9	3/4	12/ 1/49	8/29/55	5.5	+	22		−6.0	4/60		++	Normal
99	B. G.	D	58	35		6/6−	4/5	2/ 6/43	3/ 5/48	5.0		22			6/12−			Glaucoma absolute
Average				45		0.63	0.76			6.9		16			0.30			

TABLE 2C

CASES BELONGING TO GROUP II OMITTED FROM STUDY BECAUSE POSTOPERATIVE TENSION RANGED BETWEEN 25 TO 30 MM. HG

No.	Name	Eye	Tension		Refraction	Visual Acuity	Visual Fields	Iridencleisis	Date Last Examination	Years Since Operation	Filtration	Tension		Refraction	Visual Acuity	Visual Fields	Lens Opacities	Other Eye
			Without Miotics (mm. Hg)	With Miotics								Without Miotics (mm. Hg)	With Miotics					
100	S. J.	S	48	41		3/60	2/3	4/ 1/32	8/28/47	15.0	+	28		F.C. 15 cm. Temp.				Encleisis (No. 173)
101	S. O.	D	55	57		6/9	4/5	2/17/34	2/16/52	18.5	+	26		−2, −2, 90°	1.5/60	1/2−		Encleisis (No. 79)
102	T. I.	S	68	50	+2, +5, 0°	6/24	4/5	4/ 8/46	2/19/53	6.5	?		30	+1.5	6/36	2/3−		Normal
103	O. H.	S		35	−0.5	6/12+	4/5	1/30/49	4/ 2/54	5.0	?	27	22	−0.75, 90°	6/12	3/4	+	Glaucoma incipiens
104	B. M.	D	68	59	E	6/24+	1/2+	11/25/49	10/21/55	6.0	+	27		−0.5, −1, 20°	6/12	1/2+		Encleisis 1953
105	S. E.	S	68	45		6/18	2/3	11/27/38	1945	7.0			25		6/24	3/4		Encleisis 1944
Average				45		0.37	0.71			9.6					0.24	0.44		

TABLE 2D

CASES BELONGING TO GROUP II OMITTED FROM STUDY BECAUSE POSTOPERATIVE TENSION WAS ABOVE 30 MM. HG (EYES NOT REOPERATED)

No.	Name	Eye	Tension Without Miotics (mm. Hg)	Tension With Miotics (mm. Hg)	Refraction	Visual Acuity	Visual Fields	Iridencleises	Date Last Examination	Years Since Operation	Filtration	Tension Without Miotics (mm. Hg)	Tension With Miotics (mm. Hg)	Refraction	Visual Acuity	Visual Fields	Lens Opacities	Other Eye
106	F. G.	D	42	42	+1.5, 0°	6/60	2/3	2/14/33	10/17/46	13.5		58			0			Encleisis (No. 114)
107	G. C.	S	55	62		6/24	2/3	5/26/41 3/ 1/49 intracap.	4/21/53	12.0		33	+9, +4, 160°		6/12−	1/2		Encleisis (No. 118)
108	L. O.	S	35	32	+1.0	6/18	3/4	5/ 2/44	9/15/52	8.0	+	15			6/36	1/5		Glaucoma absolute
109	E. I.	D	35	34		6/9+	4/5	6/ 3/46	12/ 5/51	5.0	+	31			6/60	2/3	+	Glaucoma incipiens
110	N. O.	S	51	45	+1.5	6/6	2/3	8/22/47	9/16/53	6.0	+	32	−6, −1, 0°		6/36	1/3−		Encleisis 1954
111	E. O.	S		30		6/36	2/3	10/ 6/47	1/ 6/53	5.0		32	−2.0		6/36	2/3		Glaucoma absolute
112	T. E.	S		35	+1.5	6/12	2/3−	9/18/48	7/24/54	6.0	+	37			0			Encleisis (No. 131)
113	J. T.	D		52	−3, −0.75, 75°	6/6	3/4	2/ 7/48	10/19/54	6.5	+	36	−4, −0.75, 75°		6/9	1/3		Encleisis (No. 86)
Average				39		0.51	0.70			7.7		33			0.15	0.33		

TABLE 2E

CASES BELONGING TO GROUP II OMITTED FROM STUDY BECAUSE POSTOPERATIVE TENSION WAS ABOVE 30 MM. HG (EYES REOPERATED)

No.	Name	Eye	Tension Without Miotics (mm. Hg)	Tension With Miotics (mm. Hg)	Refraction	Visual Acuity	Visual Fields	Iridencleisis	Tension Without Miotics (mm. Hg)	Operation	Tension With Miotics (mm. Hg)	Operation	Date Last Examination	Years Since Last Operation	Filtration	Tension Without Miotics (mm. Hg)	Tension With Miotics (mm. Hg)	Refraction	Visual Acuity	Visual Fields	Lens Opacities	Other Eye
114	F. G.	S	37	37	+1, 0°	6/12	2/3	2/20/33	35	1/13/44 Cyclodial.			11/27/46	11		12			L.P.	Good project	+	Encleisis 1932
115	S. J.	S	62	50		6/9+	3/4	1/11/35	30–40	1938 Cyclodial.			1941	16		5			1/60	Periph. good Central scotoma		Glaucoma absolute
116	L. M.	S	53	41	−4.5, 0°	6/18	3/4	5/ 4/38	41	10/17/38 Reop. Encleises			9/ 8/45	12		11		−1	6/60	1/4		Encleisis 1936
117	K. K.	D	58	48	−2, −.075, 90°	6/9	2/3	6/10/40	48	9/22/40 Reop. Encleisis			10/15/48	9	+		20	−14	6/60	Donders good	+	Glaucoma absolute
118	G. C.	D	55	58		6/18+	3/4	5/29/41	48	8/30/43 Cyclodial.		10/ 8/48 Intracap.	6/ 4/52	5		9		+18.5, +1, 120°	6/18	2/3		Encleisis 1941
119	M. G.	S	47	40	+3.0	6/12	2/3	9/23/46	40	5/ 2/49 Cyclodial.			4/ 8/53	4	+		28	+2.0	6/18	2/3−		Glaucoma incipiens
120	G. M.	D		32	−2.0	6/9	4/5	10/20/48	37	1/29/53 Cyclodial.			4/ 6/54	3	−		28	+1.5, +1.25, 0°	6/12	4/5		Encleisis 1947
121	Q. J.	D		42		6/9−	4/5+	9/ 4/49	51	4/29/54 Reop. Encleisis	34	6/11/55 Cycloelectrol.	2/ 8/56	1			33		1/60		Macular degenerat.	Glaucoma absolute
Average				43		0.55	0.74												0.17			

TABLE 3A

GROUP III: GLAUCOMATOUS EYES WITH VISUAL FIELDS BEFORE OPERATION ONE FOURTH TO ONE HALF. POSTOPERATIVE TENSION NOT ABOVE 25 MM. HG

No.	Name	Eye	Tension Without Miotics (mm. Hg)	Tension With Miotics (mm. Hg)	Refraction	Visual Acuity	Visual Fields	Iridencleisis	Date Last Examination	Years Since Operation	Filtration	Tension Without Miotics (mm. Hg)	Tension With Miotics (mm. Hg)	Refraction	Visual Acuity	Visual Fields	Lens Opacities	Other Eye
122	S. G.	S	76	70	+1.0	6/9	1/2	6/21/32 6/24/38	11/ 4/42	10.0	+	15			F. C. 60 30 cm.			Encleisis (No. 59)
123	K. J.	S	60	45		2/60	1/2	3/16/34	5/28/46	12.0		20			H.M.	Temp.		Encleisis 1947
124	W. M.	S	63	57	+1, 90°	6/18	1/3	8/ 2/34	9/ 5/41	7.0		13			H.M.			Encleisis (No. 130)
125	S. O.	S		58	+2, 90°	6/60	1/4	8/ 7/34 1940 2/60 v.f. 1/6	9/12/46	12.0		22			F.C. 60 10 cm.			Cataract
126	G. M.	S	58	41	E	6/18	1/3	7/22/35 extracap. cat.	5/ 4/51	16.0	+	8.0			6/36	1/4	+	Encleisis 1952
127	L. M.	D	62	45		6/18	1/2	1/20/36 2/11/44; extracap. cat. 6/ 2/44; +12/6/18 v. f. 1/4	6/12/47	11.0		22			H.M.			Encleisis (No. 116)
128	O. H.	S	61	58	+1.0	6/9	1/2	6/13/38	1/24/51	12.5	+	13		−4.0	6/24	1/3	+	Encleisis (No. 102)
129	P. K.	S	53	48		6/36	1/3	1/ 6/40 v. f. unchanged 1947	6/25/51	11.0		12			F.C. 60 20 cm.			Encleisis (No. 92)
130	W. M.	D		48	+2.0	6/9	1/3	6/22/40	3/11/46	6.0		19		−1.0	6/36	1/4	+	Encleisis (No. 124)
131	T. E.	D	76	48	+1, +1.5, 90°	6/9	1/2	9/ 3/40	1/15/53	12.0		19		−8.0	6/18	1/2	+	Encleisis (No. 112)
132	M. R.	S	32	35	+0.75	6/18	1/2	10/11/37	4/10/45	7.5	?		23	−2.5	6/36+	1/4+		Encleisis 1937
133	G. S.	S	67	67	+1.5	6/9	1/3−	6/24/40	7/22/47	6.5	+	18		−6, −1, 20°	6/36−	1/8+	+	Operated elsewhere
134	K. K.	D	65	52	+1.0	6/18	1/2−	8/12/42	3/ 7/50	7.5	+	22		+1, +0.5, 0°	6/12	1/3+	+	Encleisis (No. 14)
135	P. J.	S	65	58	−1.5	6/24	1/3	9/ 3/43	8/ 2/55	11.0	+	8.0		−1, −0.75, 70°	6/24	1/5		Encleisis (No. 108)
136	S. J.	D	58	48	+2.5	6/24	1/2	3/15/43 6/27/52 intracap. cat.	9/25/52	9.5		18		+10, +4, 0°	6/9	1/2		Encleisis 1952
137	S. T.	D	45	45		6/24	1/2	3/17/43	10/ 9/52	9.5	+		25	−1, 90°	6/18	1/3	+	Thrombosis central vein
138	S. H.	S	48	41	+1, +0.5, 0°	6/9	1/2	4/23/45	6/10/51	6.0	+	19		−4, −0.75, 90°	6/18	1/10	+	Normal
139	B. K.	S	45	50	+1.0	6/18	1/3	5/13/46	11/27/52	6.5	+	23		+1.0	6/18	1/2		Glaucoma absolute
140	F. K.	S	47	38	E	6/18	1/4	2/11/47	7/13/53	6.0	+	15			6/36	1/8		Normal
141	K. O.	S	40	42		6/12	1/4	8/29/47	2/16/55	7.5	+	17		−1.5, −2, 0°	6/12	1/4		Glaucoma incipiens 1953
142	L. K.	D	51	32		1/60	1/2	2/10/47	12/ 4/52	5.5	+	19			H.M.	Temp.		Encleisis (No. 76)
143	N. B.	S	68	45	−1.0	6/6	1/4	1/10/47	1/27/53	6.0		15		−1.25, −0.75, 90°	6/18−	1/6−	Traces	Encleisis 1952
144	S. A.	S	48	40	−8, −2, 15°	6/18	1/4	8/11/47	9/17/52	5.0	+	25			H.M.			Normal
145	S. A.	S	33	27	E	4/60	1/2	2/ 3/47	4/10/53	6.0	+	15			6/60−	1/2−		Encleisis 1947
146	R. A.	S		35	−3.5	6/18	1/3	6/14/48	8/30/54	6.0		19		−6.0	6/36	1/3−		Cataract immature
147	G. L.	S	48	35	−1.0	6/18	1/2	3/16/49	11/16/54	5.5	+	13		E	6/18	2/5		Anophthalmos
Average				45		0.38	0.40			8.5		17.6			0.2	0.19		

TABLE 3B

CASES BELONGING TO GROUP III OMITTED FROM STUDY BECAUSE VISUAL FIELDS WERE NOT TAKEN AT LAST EXAMINATION

No.	Name	Eye	Tension		Refraction	Visual Acuity	Visual Fields	Iridencleisis	Date Last Examination	Years Since Operation	Filtration	Tension		Refraction	Visual Acuity	Visual Fields	Lens Opacities	Other Eye
			Without Miotics (mm. Hg)	With Miotics (mm. Hg)								Without Miotics (mm. Hg)	With Miotics (mm. Hg)					
148	N. A.	D	58	48		F. C. 50 cm.	1/2	10/16/37	12/21/44	7.0	+	6			F.C. @ 1 m	Temp.		Encleisis (No. 33)
149	T. P.	D	58	48	−10	3/60	1/2	11/24/41	3/17/48	6.0	+	20			1.5/60	Not recorded		Normal
150	S. S.	S	58	48	+1.5, 165°	6/18	1/3	8/16/41	4/17/47	5.5	+	22		−1.5, 70°	6/24		+	Lens opacities
151	S. B.	D	58	48	E	6/24	1/4+	6/19/45	9/ 4/51	6.0	+	17		−2.5	6/24−			Encleisis (No. 84)
Average				48		0.16	0.40					16			0.12			

TABLE 3C

CASES BELONGING TO GROUP III OMITTED FROM STUDY BECAUSE POSTOPERATIVE TENSION RANGED BETWEEN 25 TO 30 MM. HG

No.	Name	Eye	Tension		Refraction	Visual Acuity	Visual Fields	Iridencleisis	Date Last Examination	Years Since Operation	Filtration	Tension		Refraction	Visual Acuity	Visual Fields	Lens Opacities	Other Eye
			Without Miotics (mm. Hg)	With Miotics (mm. Hg)								Without Miotics (mm. Hg)	With Miotics (mm. Hg)					
152	S. A.	D		48	−8, −1, 0°	6/18	1/2	10/27/34 1941 −1.5 6/60	1945	10			30		H.M.			Encleisis 1929

TABLE 3D

CASES BELONGING TO GROUP III OMITTED FROM STUDY BECAUSE POSTOPERATIVE TENSION WAS ABOVE 30 MM. HG (EYES NOT REOPERATED)

No.	Name	Eye	Tension		Refraction	Visual Acuity	Visual Fields	Iridencleises	Date Last Examination	Years Since Operation	Filtration	Tension		Refraction	Visual Acuity	Visual Fields	Lens Opacities	Other Eye
			Without Miotics (mm. Hg)	With Miotics (mm. Hg)								Without Miotics (mm. Hg)	With Miotics (mm. Hg)					
153	V. J.	S	68	48	+1.0	6/9	1/2	11/16/35	9/17/52	16.5			68		0			Encleisis 1952
154	P. E.	D	48	58		6/12+	1/3	5/12/37	8/ 6/45	8.0			48		H.M.			Encleisis (No. 10)
155	D. B.	S	55	48	E	6/12	1/4	4/ 3/43 1949; Tension 53	11/28/50	7.0			22		H.M.			Encleisis 1956
Average				51		0.57	0.36						46		0			

TABLE 3E

Cases belonging to Group III omitted from study because postoperative tension was above 30 mm. Hg (eyes reoperated)

No.	Name	Eye	Tension With-out Mio-tics (mm. Hg)	Tension With Mio-tics (mm. Hg)	Re-frac-tion	Visual Acuity	Visual Fields	Iriden-cleisis	Reoperation	Date Last Examina-tion	Years Since Last Opera-tion	Fil-tra-tion	Tension With-out Mio-tics (mm. Hg)	Tension With Mio-tics (mm. Hg)	Re-frac-tion	Visual Acuity	Visual Fields	Lens Opaci-ties	Other Eye
156	B. S.	D	63	48	+1.0	6/12	1/3	7/ 6/34	1937 Encleisis 1939 Cyclodial	4/30/42				36		F.C.	Temp.		Encleisis 1943
157	R. M.	D	58		−1, 90°	6/12	1/2	6/18/40	1943 Elsewhere	12/11/50	10.5		17			H.M.	Temp.	++	Normal
158	K. P.	S	68	58	E	6/24	1/4	11/23/45	1946 Encleisis	8/29/52	6.5	+		32		F.C. 1 m.	1/6		Normal
159	E. P.	S	68	32	E	6/18	1/2	11/15/45	1947 Cyclodial	4/21/53	6.5		11			L.P.			Glaucoma incipiens
Average				46		0.4	0.4									0			

about refraction. Of the remaining 18, eight (128, 130, 131, 132, 133, 138, 141, 146) had an increase of refraction of more than one diopter; the average was five diopters. Of these eight only one belongs to the group with preserved visual acuity. For nine eyes, lens opacities were noted (126, 128, 130, 131, 133, 134, 137, 138, 143).

At the last examination, eight eyes had no usable sight (a visual acuity of not more than finger counting at 20-cm. distance); two had a visual field of 1/10 or less, with visual acuity of 6/18. These eyes, together with 16 with better function, still had some usable vision.

Summary for Group III

For eyes that immediately before the operation had visual fields restricted to between one half to one fourth of normal, the prospects for preservation of the visual field for a period of nine years seemed considerably reduced. This group showed an average loss of visual field of 20 percent of normal and in only five of 26 eyes was the visual field completely or almost completely unchanged.

Loss of visual acuity in the group seems to agree quite well with the loss in Groups I and II. More eyes in this group had unchanged visual acuity (8) than unchanged visual fields (5). The same tendency to increase of refraction in this group is also obvious, just as in Group I and Group II. Eighteen out of 26 eyes may be said to have preserved some useful visual function.

Group IV

The group is comprised of 13 eyes which immediately before operation had visual fields restricted to one fourth or less of normal visual fields. The average tension of this group before operation was 52 mm. Hg; at the last postoperative examination, 16 mm. Hg, on an average. The time of observation for this group averages eight years.

Visual fields

During the time of observation, the visual fields in this group decreased on an average from 0.16 to 0.07. Out of 13 eyes, 10 had a distinct loss of visual field during that period.

Visual acuity

Visual acuity during the time of observation decreased on an average from 0.37 to 0.20. Two out of 13 eyes (167, 169) had unchanged or improved visual acuity. In four eyes visual acuity deterioration was comparatively small. Six out of 13 preserved a visual acuity of more than 6/60; in two of these, there was an increase of refraction averaging five diopters. Six out of 13 eyes had finger counting at 20 cm. or less and so were without useful visual function. Apart from these six, four eyes with visual acuity of more than 6/60 had a visual field of 1/10 or less (before operation, respectively, 1/8, 1/6, 1/8, and 1/8).

Warnings have been issued against operation of eyes with excessively restricted visual fields because rapid deterioration, especially of the central vision, was feared. My Group IV does not confirm this view. Eleven eyes of this group had some degree of central vision at the time of operation, most often an island in the central visual field. Six of these eyes had retained some central vision at the last observation, on an average 7.6 years after operation. The last five had some central vision after three, two, one and one-half, and ?, and ? years but had lost it after five, eight, 10, 10, and two years.

Summary for Group IV

For eyes with a visual field restricted to one fourth or less before operation prospects are not so good for the preservation either of the visual field or the visual acuity during a period of eight years.

It is remarkable, however, that in this poor group, seven out of 13 eyes preserved a visual acuity of 6/60 or more.

TABLE 4A

Group IV: Glaucomatous eyes with visual fields before operation less than one fourth. Postoperative tension not above 25 mm. Hg

No.	Name	Eye	Tension (mm. Hg) Without Miotics	Tension (mm. Hg) With Miotics	Refraction	Visual Acuity	Visual Fields	Iridencleisis	Date Last Examination	Years Since Operation	Filtration	Tension (mm. Hg) Without Miotics	Tension (mm. Hg) With Miotics	Refraction	Visual Acuity	Visual Fields	Lens Opacities	Other Eye
160	B. H.	D	77	77	+6	6/36	1/6	5/27/31	3/23/39	8.0		22			H.M.			Encleisis 1931
161	B. O.	D	56	61	−0.5	6/12	1/4	10/ 7/31	1/17/39	8.0		22			F.C.		Temp. rest	Encleisis 1939
162	O. H.	D	75	48		6/12	1/10	3/21/33 1936: 6/12 1938: 2/60	5/27/51	18.0		17			0			Encleisis (No. 128)
163	V. L.	S	67	59	E	6/9	1/5	9/14/35 1½ år	5/13/42	5.5	+	11			6/24		1/6	Glaucoma absolute
164	N. E.	S	63	48		6/24	1/5	4/21/37 1½ år 6/24	12/13/47	10.5	+	8			H.M.		Temp. rest	Encleisis (No. 34)
165	S. A.	S	68	58		3/60	1/8	6/ 8/37		5.0		17			F.C. @ 20 cm.		Temp. rest	Encleisis 1942
166	R. O.	D	68	35	+1.5	6/18	1/6	1/10/40	5/14/52	12.0	+	6		−1.0	6/24−		1/3	Encleisis 1950
167	G. S	S	49	45		6/60	1/8	9/ 4/41	4/11/47	5.5	+	17			H.M.			Cataract senile
168	P. J.	D	78	58		6/18	1/6	8/31/43	8/ 2/55	12.0	+	10		−1, 90°	6/24		1/10	Encleisis (No. 135)
169	S. I.	D		58	+1.5	6/18	2/5	3/15/43	8/22/48	5.0	+	20		+1.0	6/9+		1/6	Normal
170	N. O.	S	51	51	+0.5, 0°	6/6	1/8	11/28/47	10/ 1/53	5.5	+	22			6/9		1/20	Encleisis (No. 25)
171	A. R.	D		35		3/60	1/10	5/10/49	2/21/55	5.5			23		0			Cataract
172	M. A.	D	59	45	−2.0	6/12+	1/8	5/ 3/49	12/22/54	5.5		12		−1.0	6/18		1/20	Glaucoma absolute
Average				52		0.37	0.16			8		16			0.20		0.07	

TABLE 4B

CASES BELONGING TO GROUP IV OMITTED FROM STUDY BECAUSE VISUAL FIELDS WERE NOT TAKEN BEFORE OR AFTER OPERATION

No.	Name	Eye	Tension		Refraction	Visual Acuity	Visual Fields	Iridencleisis	Date Last Examination	Years Since Operation	Filtration	Tension		Refraction	Visual Acuity	Visual Fields	Lens Opacities	Other Eye
			Without Miotics (mm. Hg)	With Miotics								Without Miotics (mm. Hg)	With Miotics					
173	S. J.	D	41	35		H.M.	Temp.		8/28/47	15.0	+		28		H.M.			Encleisis (No. 100)
174	H. O.	D	68	45		6/60−	1/20	1/16/34		5.5			30		F.C.			Encleisis (No. 89)
175	S. H.	D	39	39	+3, 0°	6/24	1/6	1/13/33	5/ 1/46	13.0		21			H.M.		++	Glaucoma absolute
176	T. K.	D	58	48	E	6/12	1/10	6/ 6/39	10/ 8/48	9.0		22		−6.0	4/60	Not recorded	+	Normal
177	D. K.	D		68	+40, 90°	6/24	1/10	2/22/44	11/ 8/49	5.5	+	15		−4, 15°	5/60	Not recorded		Encleisis (No. 67)
178	S. K.	S	88			F.C.	Not recorded	9/27/43	1953	10.0			50		0			
179	O. O.	S	88	78		H.M.		1/28/44	1/29/54	10.0	+	17			H.M.	Temp.		Encleisis (No. 29)
180	J. M.	S	58	52		H.M.	Temp.	5/15/46	1948 1955	9.0	+	22			H.M. 0			Encleisis (No. 52)
181	M. O.	S	48	45		F.C.	Temp.	8/14/47	6/30/53	5.5	+	25			L.P.			Encleisis 1949
182	N. O.	S	58	40		H.M.	Temp.	3/14/47	10/20/52	6.5	+	25			H.M.	Temp.		Encleisis (No. 43)
183	R. O.	D		68		F.C.		4/29/49	6/18/56	7.0	+	22			F.C.			Normal
184	N. O.	S		42		F.C.	Temp.	5/27/48	9/ 8/55	7.0	+	34			L.P.			Normal
Average				51						8.6								

TABLE 4C

CASES BELONGING TO GROUP IV OMITTED FROM STUDY BECAUSE POSTOPERATIVE TENSION RANGED BETWEEN 25 TO 30 MM. HG

No.	Name	Eye	Tension		Refraction	Visual Acuity	Visual Fields	Iridencleisis	Date Last Examination	Years Since Operation	Filtration	Tension		Refraction	Visual Acuity	Visual Fields	Lens Opacities	Other Eye
			Without Miotics (mm. Hg)	With Miotics								Without Miotics (mm. Hg)	With Miotics					
185	S. K.	S	78	58	+1.0	6/9	1/50	6/19/45	3/ 6/52	6.5	+		28		0			Encleisis (No. 70)
186	N. A.	D	58	48	+1.0	6/12	1/10	2/13/46	10/26/52	6.5			27	−7.0	6/24	1/10		Encleisis (No. 189)

TABLE 4D

CASES BELONGING TO GROUP IV OMITTED FROM STUDY BECAUSE POSTOPERATIVE TENSION WAS ABOVE 30 MM. HG (EYES NOT REOPERATED)

No.	Name	Eye	Tension		Refraction	Visual Acuity	Visual Fields	Iridencleisis	Date Last Examination	Years Since Operation	Filtration	Tension		Refraction	Visual Acuity	Visual Fields	Lens Opacities	Other Eye
			Without Miotics (mm. Hg)	With Miotics								Without Miotics (mm. Hg)	With Miotics					
187	S. O.	D	55			F.C.	1/30	2/21/47	10/16/52				50		L.P.			Encleisis 1947

TABLE 4E

CASES BELONGING TO GROUP IV OMITTED FROM STUDY BECAUSE POSTOPERATIVE TENSION WAS ABOVE 30 MM. HG (EYES REOPERATED)

No.	Name	Eye	Tension		Refraction	Visual Acuity	Visual Fields	Iridencleisis	Reoperation	Date Last Examination	Years Since Operation	Filtration	Tension		Refraction	Visual Acuity	Visual Fields	Lens Opacities	Other Eye
			Without Miotics (mm. Hg)	With Miotics									Without Miotics (mm. Hg)	With Miotics					
188	H. L.	D	75	51		6/18	1/10	9/8/33	11/33 Encleisis	4/18/39	6.0		19			0			Encleisis 1939
189	N. A.	S	45	41	E	6/24	1/10	2/20/46	1948 Cyclodial 1949 Cyclodiath.	10/16/52	6.5			28	−5.0	6/60−	1/10		Encleisis (No. 186)

Conclusion and Summary

In the material herein studied, glaucoma simplex has a considerably higher frequency in men than in women. The figures for operated eyes are: male, 666; female, 391. The ratio of males to females in the 50-70 years age group in my county for the year 1950 was 503 males: 497 females.

A total of 148 patients with 189 eyes on which glaucoma operations had been performed were observed for more than five years, on an average 8.11 years. In 117 of these patients, the second eye showed at some time during the observation period signs of glaucoma.

My material confirms the importance of early operation, especially for the retention of the visual field. In the two groups with unrestricted and moderately restricted visual fields immediately before the operation, the loss in visual field after eight years was very moderate (on an average seven percent of a complete visual field) and every eye retained serviceable function.

In the two groups with loss of more than one half of the visual field before operation the prognosis seems to be poorer (from 0.40 to 0.19 and from 0.16 to 0.07 of a complete visual field). Eighteen out of 26 and six out of 13 eyes in these groups can be said to have retained some useful visual function.

My series indicate that it is too optimistic to expect a full retention of visual acuity, for a number of years. Here the difference between the groups is not so great. During an average of eight years the loss in all groups in acuity measured about 20 percent of a full visual acuity (0.73 to 0.50, 0.59 to 0.40, 0.38 to 0.20, and 0.37 to 0.20). The chief cause for this loss appears to be a special kind of cataract, the increase in refraction being due to swelling of the lens nucleus.

Of 83 eyes with refraction recorded at the last examination, 32 (38.5 percent) had, during the observation period of eight years, an increase in refraction of at least two diopters, the average increase being 4.5 di-

opters. Sixty-nine percent of the eyes with a loss of more than two lines on the Snellen chart (18 out of 26) belong to this group, and lens opacities were recorded at the last examination in this same number of eyes.

My material confirms that glaucoma surgery is not the only cause of these lenticular changes in cases with progressive myopia in the glaucoma-operated eye. I have found the same changes in the second eye, even if this eye had an unoperated glaucoma or no glaucoma at all. However, the degree, as well as the frequency, of the process seems to be higher in glaucoma-operated eyes.

My studies indicate that an especially low postoperative intraocular pressure is not the cause of these lenticular changes. The average pressure in 32 eyes with considerable increase of refraction was 17.8 mm. Hg; the average tension for the remainder (50 eyes with refraction stated at the last examination, omitting two eyes operated for cataract) was 17.1 mm. Hg.

This survey also indicates that we may not give our glaucoma-operated patients the prognosis of full retention of visual function. But we are justified in telling them that a surgical regulation of the pressure at an early stage of the disease provides a very good chance for retention of useful visual function for a period of at least eight years.

Saint Torfinns Eye Clinic.

PROGRESSIVE LAMELLAR RADIATION CATARACTS IN THE NEWBORN MOUSE*

A PRELIMINARY REPORT

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Production of cataracts in newborn animals exposed to ionizing radiation has been described by several investigators. The early literature was reviewed by Desjardins.[1] Lorenz and Dunn,[2] using a dose of 400 r of X rays in newborn mice, found cataracts as early as four months after irradiation. The eyes were not examined by slitlamp, and no observations on the progression of the lesion were made. Under the dissecting microscope, however, they noted that the lens opacity was attributable to an opaque, stony-hard nucleus, whereas the cortex was soft. Vogel[3] exposed the heads of newborn mice to varying doses of X rays and found that lens opacities did not occur with doses less than 400 r. With this dose he did not observe lens opacities until the mice were at least 104 days old. Except for giving the number of eyes with a white opacity after varying intervals of time, he gave no details of the configuration or progression of the cataract, the method of examination being limited to observation with the naked eye and with the ophthalmoscope.

This report describes in detail the development and clinical course of radiation cataracts induced in mice by X irradiation on the day of birth.

MATERIAL AND METHOD

Within 24 hours after birth, newborn RF mice were exposed by litters to 100, 200, and 300 r of whole-body X radiation. The factors

* From the Biology Division, Oak Ridge National Laboratory, which is operated by Union Carbide Nuclear Company for the U. S. Atomic Energy Commission. This material was presented at the Wilmer Residents' meeting, The Johns Hopkins Hospital, Baltimore, Maryland, April 4, 1957.

of irradiation were 250 kvp, 30 ma, TSD 93.7 cm, 3 mm. of Al added filtration, hvl 0.44 mm. of Cu, rate 80 to 100 r per min. The animals were marked with dye at first and later earmarked so that the fate of individual eyes could be followed. The following numbers of animals were used in each exposure group:

Number of controls	17
Number exposed to 100 r	20
Number exposed to 200 r	28
Number exposed to 300 r	32

The newborn mice were returned to the mother after exposure and allowed to mature under normal conditions. Observations to date have extended for 19 months in some groups. All the mice have been examined at regular intervals varying from once a week to once a month. The pupils were dilated before each examination with five-percent homatropine and the eyes inspected with a Zeiss-Opton slitlamp, a magnification of at least 16 times being used. The first examination was made within one to three days after the eyes opened spontaneously; generally, this was about two weeks after birth. The eyes were then examined at weekly intervals for the next four to six weeks, at intervals of two weeks for the following two to three months, and at monthly intervals thereafter.

Results

All animals exposed to 200 r or more had a lens opacity at the first examination; that is, at about two and one-half weeks after birth and exposure (fig. 1). At the third week of age, this opacity was easily seen to be located in the lens nucleus. This was a lamellar type of cataract. In the first few weeks of examination, anterior subcapsular vacuoles were present in addition to the nuclear opacity in nearly all eyes.

Some of the cataracts induced by 200 r of X-rays progressed slightly in severity, but most remained constant or actually regressed in density as the mice grew older. In contrast, mice exposed to 300 r of X rays did not show regression of the nuclear opacity. The more rapidly progressive cataracts became subluxated and usually, but not always, ended in complete opacification, with features of a Morgagnian cataract. Nuclear cataracts have not been observed in the controls or in the mice exposed to 100 r of X rays.

Grading and description of the cataracts

At the time of the first examination, a faint, whitish, translucent haze was present in the posterior subcapsular region, which was visible only with oblique illumination. This was called a *grade I* cataract (fig. 2).

A week later the characteristic feature of these cataracts was more easily apparent, the opacity being a well-developed, whitish, translucent haze affecting the posterior surface of the embryonic nucleus and definitely outlining its equatorial zone. Myriads of small white dots were seen in the translucent haze. Curiously, the anterior surface of the nucleus was not similarly affected. This stage was classified as a *grade II* cataract. In addition to the nuclear opacity, anterior subcapsular vacuolation of the lens was almost constantly present, ringing the lens equator. These vacuoles were spokelike in arrangement, with the apex pointed to the anterior pole of the lens. Occasionally there were also centrally located, anterior subcapsular vacuoles of varying size and shape. All these anterior subcapsular vacuoles disappeared entirely after two to three weeks, leaving no residual lenticular defect.

In a *grade III* cataract the nuclear opacity progressed in density, giving rise to a very sharp zone of discontinuity between the nucleus and the cortex. Typically, there developed one or more dense, irregularly shaped, posterior capsular or subcapsular whitish opacities which characterized this grade.

In lenses that developed more severe cataracts, the anterior fibers of the nucleus then became visible as individual fibers along with development of a more dense sheetlike

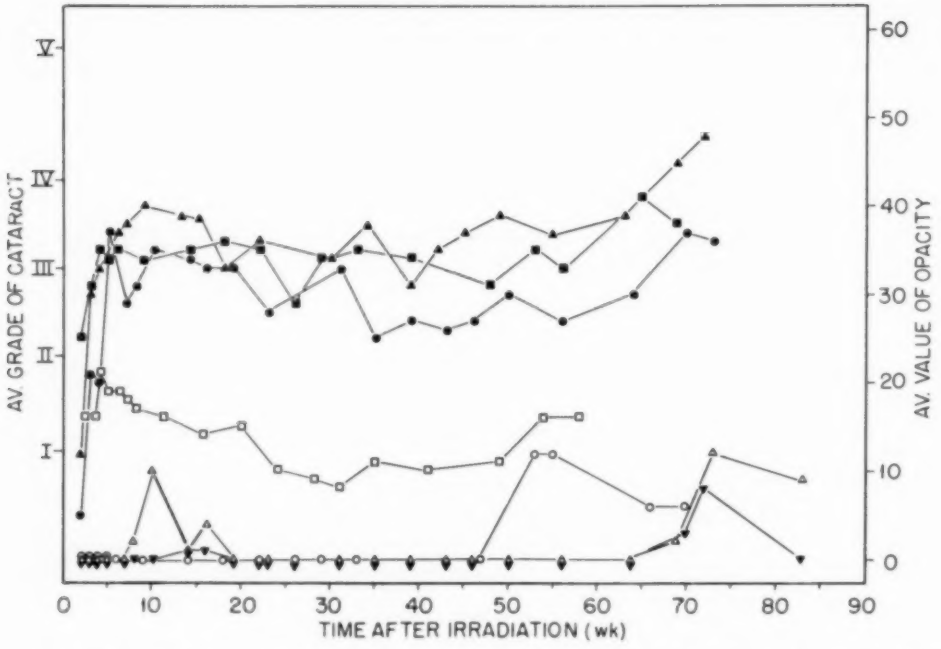

Fig. 1 (Benedict). Progression and severity of lens opacities with time after irradiation. The grades of lens opacity (shown in fig. 2) were given arbitrary numerical values as follows: *Grade O*, 0; *I*, 12; *II*, 23; *III*, 33; *IV*, 43; *V*, 58; *VI*, 78. The average numerical value for all eyes in each experiment for each week of observation was then determined. Not all eyes in each experiment progressed at the same rate, and so, as animals died, the average numerical value of the group would change slightly from week to week. The early variation in the 100 r and control animals was attributable to a questionable opacity that was not consistently seen and was probably an artifact. In the later stages of the experiment, senile cortical opacities for the changes in the latter groups. O, control (expt. 2); △, 100 r; □, 200 r; ●, 300 r (expt. 1); ▲, 300 r (expt. 2); ■, 300 r (expt. 3).

opacity of the posterior surface of the nucleus. This was called a *grade IV* cataract. Eventually, the entire nucleus became opaque, and the large plaquelike opacities in the posterior subcapsular region of the lens were less easily visible, because they were covered by the nuclear opacity.

At the next stage, the entire lens became slightly subluxated, usually posteriorly and superiorly. The subluxation most commonly began at the inferior pole of the lens and was associated with a deepening of the anterior chamber and a failure of the pupil to dilate maximally. This was called a *grade V* cataract.

In the advanced stages, the pupil dilated hardly at all; the cataractous lens was entirely dislocated; the opaque nucleus was eccentrically located in the lens; the cortical fibers of the lens became vacuolated, and eventually they also became opaque in a few cases. This was called a *grade VI* cataract. Usually the capsule of the lens ruptured. The highly vacuolated lens cortex underwent absorption to some degree, and the capsule contracted, leaving a small crenated-looking lens. In one or two eyes that have been observed for nearly two years, the nucleus has been seen to be completely extruded from the lens capsule and to become separated from the other lens remnants. In one eye the nucleus was in the anterior

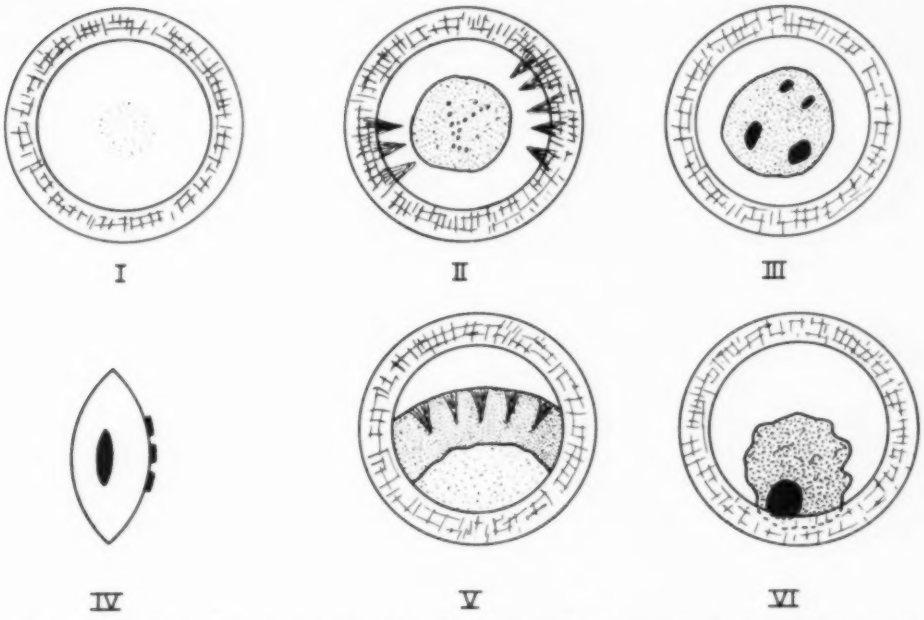

Fig. 2 (Benedict). Diagrammatic sketches of radiation-induced cataracts in the newborn mouse. *Grade I* shows an accumulation of opacities located at the posterior capsular surface of the lens. *Grade II* shows the nuclear opacity and some peripheral anterior subcapsular vacuoles. *Grade III* shows the nuclear opacity plus heavy posterior capsular deposits. *Grade IV* shows the nuclear opacity involving the whole nucleus, in contrast to the previous grades in which the opacity is confined to the posterior surface of the nucleus. *Grade V* shows the lens to be dislocated, and *Grade VI* shows the lens almost completely opaque and the nucleus in an eccentric position.

chamber and the rest of the lens was located inferior, temporal, and posterior to the usual lenticular position.

Comment

The progression of the lenticular defect is usually, but not always, similar in both eyes. The stages of opacification are very distinctive. Generally, it is a matter of only a few weeks for the opacity to change from an early nuclear transluscent haze to a subluxated lens, but after this it is a matter of months for the cortical fibers to become opaque or for the capsule to rupture.

Animals exposed to 200 r of X rays do not develop the severe opacity with dislocation just described. In these, the lens changes do not progress beyond a definite but incomplete nuclear opacity, with posterior subcapsular opacities. Some do not even develop the posterior polar opacity, and these lenses demonstrate a surprisingly marked ability to recover from radiation injury: the posterior nuclear haze thins out so as to become almost invisible, the zone of discontinuity becomes very indistinct, and the only evidences remaining for prior, well-developed opacification are a few small white dots at the level of the posterior surface of the nucleus.

To a certain extent, these cataracts closely resemble the lamellar cataracts seen in infants whose mothers had rubella during the first trimester of pregnancy. It is interesting to note that the stage of development of the mouse eye at birth is comparable to the human fetus eye at three months' gestation. Whereas, in the adult lens, radiation injury

causes primarily a cortical cataract, with little or no involvement of the nucleus, radiation injury of the developing lens results in a nuclear opacity. Although these differences probably reflect age-dependent variations in radiosensitivity of different parts of the lens related to growth and development, this aspect of the problem is not well understood and is the subject of continuing investigation.

Summary

Nuclear lens opacities are induced in newborn mice by exposure to 200 r of X rays on the day of birth. This dose, however, does not consistently produce progressive lamellar cataracts such as observed with a dose of 300 r of X rays. Regression of the lens opacity occurs in some instances after exposure to 200 r.

Lamellar cataracts produced by 300 r of X rays are visible when the eyes first open at two weeks of age and progress within several weeks to complete opacification and subluxation of the lens. They are, therefore, vastly different from the cataracts induced in older mice by ionizing radiation, which develop more slowly and involve primarily the cortex of the lens.

No lamellar opacities are induced by 100 r of X rays or are noted in nonirradiated controls.

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Acknowledgment

I am grateful to Mrs. E. S. Ledford for technical assistance and to Dr. K. W. Christenberry for first calling my attention to the lamellar opacities herein reported and for assistance in preparing the sketches of them.

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CLINICAL PATHOLOGIC CONFERENCE*

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and
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Case 1§

Clinical history

A 78-year-old Negro who was in good general health was admitted to the hospital for treatment of a progressive ulcer in his right cornea. He was known to have had bilateral chronic open-angle glaucoma, which had produced blindness in the right eye two years before admission. The left eye still had a visual acuity of 20/70, but there was only a five-degree central field.

For about 18 months the patient had noted a scratchy sensation in the right eye, assumed to be due to bullous keratopathy. The eye became very irritated and interfered with

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§ AFIP Accession No. 787296.

the patient's ability to work at his job as furnace fireman. He had been on miotic therapy and it was believed that sensitivity to these agents had developed. Therefore, miotics were stopped and he was given hydrocortisone ointment. A corneal ulcer developed in the right eye during treatment with hydrocortisone.

When he was admitted to the hospital, the corneal ulcer measured 5.0 by 7.0. It was situated in the lower temporal part of the central cornea and it had a "flat, nonpyogenic appearance." There was a moderate mucus discharge from the conjunctiva. Smears were prepared but no pathogenic organisms found. Cultures were reported "negative." Treatment with Diamox was begun and aureomycin ointment and isopto-cetamide were used locally. Three weeks later the topical therapy was changed to neosone and polymyxin B. The ulcer did not respond but became covered by a "whitish overgrowth." This was removed but was not examined. After about a week of therapy with neosone and polymyxin, a large hypopyon developed and the eye became more irritated. Enucleation was performed one month after admission.

Clinical discussion and differential diagnosis

Dr. Gibson: In recent years many new therapeutic agents have become available for the treatment of ocular disease. The antibiotics, the chemotherapeutic agents, the carbonic anhydrase inhibitors, and the corticosteroids are among the recent preparations that have widened our therapeutic horizon. These newer agents provide the clinician with two divergent avenues through which to approach therapy. He may proceed cautiously, utilizing these agents with due regard for their limitations and contraindications, in combination with proven forms of treatment, or he may employ them more or less at random as a substitute for thought and thoroughness. The case histories selected for this conference suggest that some choose the less commendable of these two courses.

The two cases to be discussed here have similar histories, the principal feature of which is progressive corneal ulcer in a glaucomatous eye. Both terminate with enucleation, the ultimate in undesirable end-results. The primary purpose of reviewing the history, clinical features, therapy, and histologic findings in these cases is to determine how a more favorable end-result might have been achieved. To the attainment of this end, definitive diagnosis and the application of sound therapy are basic. While these objectives could not unquestionably have been attained with the information available in the histories, there are many features which serve as a basis for discussion of diagnostic and therapeutic principles which are in need of review.

The clinical course of corneal ulcers should be characterized by relatively rapid repair. When ulcers remain stationary or progress, it can safely be assumed that factors which adversely influence the process of immunity or repair are operating. Some of these factors may be obvious, while others are obscure, unknown, or identified with difficulty. I suspect that such is the case in the first patient. It is reasonable to assume that senility and even arteriosclerosis were possible contributing factors even though it was stated that the patient's general health was good. There is no reason to suspect adnexal disease, since a mucous discharge was the only sign or symptom of disease in these quarters mentioned. The functional integrity of the corneal branches of the trigeminal nerve should never be overlooked in the presence of an intractable corneal ulcer. The clinical history does not suggest neuroparalytic keratitis, but it would be helpful to be reassured that corneal sensitivity was normal. The increased intraocular pressure and the resultant elevated tissue tension in the cornea, in all probability have some influence upon the corneal nerves; this might be a factor both in the initiation and

in the perpetuation of the ulcer.

Since the eye had been blind for two years before admission, it would seem that the unfavorable response to treatment could be partly attributed to degenerative changes in the cornea. The degenerative changes secondary to advanced glaucoma in a blind eye are band keratopathy and pannus degenerativus. The negative culture and the nonpyogenic appearance of the ulcer make the consideration of nonbacterial causes of progressive corneal ulcer necessary.

Neuroparalytic keratitis has been considered. The description and relatively central location of the ulcer does not suggest Mooren's ulcer, which is oriented in relation to the limbus, and usually is not accompanied by the development of hypopyon. Viral ulcers, such as dendritic keratitis, and the subsequent nonviral metaherpetic keratitis are rare in glaucoma. Furthermore, the clinical course here does not suggest this possibility, but does not altogether exclude it.

Fungus contamination is a possibility and, therefore, should have been excluded by appropriate study of the whitish overgrowth which was removed. The role of pyogenic bacteria in this pathologic sequence cannot be dismissed on the basis of negative cultures. Errors in the timing and taking of the material, the previous use of antibiotics, and numerous other possibilities invalidate the significance of negative cultures.

With the interruption of the continuity of corneal epithelium suggested by the scratchy sensation and irritability of the eye preceding the onset of ulcer, bacterial infection at some stage of the process is highly probable. Examination of smears of the discharge might have helped in determining the type of cytologic response.

Failure to isolate a specific bacterial invader makes the selection of any antibiotic a matter of chance. That this ulcer did not respond to therapy must be partly attributed to the uncontrolled glaucoma. We shall have to assume that the patient was afflicted with true primary glaucoma, but must not forget that intraocular neoplasm, though undemonstrable, is always a possible cause of elevated tension. The most likely sequence of events in this case is inadequately controlled primary glaucoma, blindness, corneal degeneration or devitalization, bullous keratitis, infection, perhaps by a pneumococcus, the development of a superinfection, perhaps by a rare secondary invader such as Aspergillus, the development of ulcus serpens, and hypopyon which necessitated enucleation.

The lack of a definite diagnosis is, however, dwarfed in importance by the clinical management, which leaves much to be desired. The patient's ability to co-operate and carry out his treatment is open to question.

The first factor to be discussed is prophylaxis. It is safe to venture that adequate antiglaucomatous measures would have prevented this unfortunate sequence of events. There is a growing tendency, in some circles, to advocate conservative nonoperative therapy for long-term control of simple glaucoma. This patient's history points up just one of the many reasons for questioning the desirability of such therapy. Drug intolerance should be anticipated rather than come as a surprise. In spite of the well-known inadequate response of the Negro eye to surgical measures for control of glaucoma, it is probable that properly timed surgical regime would have prevented the catastrophe in this case.

The second basic therapeutic principle in eyes simultaneously afflicted with glaucoma and corneal ulcer is that the tension must be reduced to a normal or near-normal level before beneficial effects can be anticipated from the measures designed to control the ulcer. When a reduction of the ocular tension is not possible by medical means, prompt paracentesis is mandatory.

The next important consideration is atropinization. The chances for successful control of major corneal ulcers in nonatropinized eyes are slight. Atropine must be used following the paracentesis. After these measures have been employed it is time to con-

sider treatment of the ulcer. The indiscriminate parade of medicinal agents under circumstances in which none of them could be expected to exert a favorable influence on the course of the disease is not good therapy. The random use of all the new medicines in defiance of the basic principle of therapy is not defensible. Their use as a substitute for miotics is difficult to rationalize, though their empirical use as supplementary therapy is justifiable under such desperate circumstances. Principal reliance should be placed on proper surgical treatment of the glaucoma and the ulcer before auxiliary pharmaceutical forms of treatment are used.

Proper surgical therapy in this case after the ulcer developed would consist of diathermic fulguration of the ulcer as the first step. Paracentesis should be done at the same time. Diathermic fulguration is specific for all primary and secondary invaders and also destroys their toxins and the necrotic tissue which harbors organisms and impedes repair. Paracentesis reduces tension and improves the natural defense mechanisms of the corneal tissue. The benefits of fresh aqueous are well known. Diamox could not conceivably be of lasting benefit. The employment of antibiotics and chemotherapeutic agents in this patient reflects an allegiance to these drugs which far exceeds their effectiveness.

Pathology

Dr. Zimmerman: Dr. Gibson's splendid discussion of this case has driven to the heart of the problem as you shall see momentarily. Examination of the specimen in the laboratory confirmed the clinical description of a glaucomatous right eye with a deep central ulcer, diffuse haziness of the surrounding cornea, hypopyon, and ciliary injection. Microscopically, the corneal stroma centrally was reduced to less than half its normal thickness as a result of the destruction of all superficial layers (fig. 1). The ulcer bed was composed of necrotic stromal tissue intensely and diffusely infiltrated by

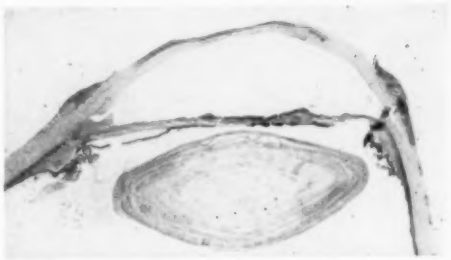

Fig. 1 (Zimmerman and Gibson). *Case I.* An extensive area of acute necrotizing keratitis with ulceration of the outer half of the central cornea. (Hematoxylin-eosin, × 8.)

polymorphonuclear leukocytes (fig. 2). About the margins of the ulcer, edematous epithelium remained. This, as Dr. Gibson suggested, was separated from Bowman's membrane by a vascular pannus which was intensely infiltrated by chronic inflammatory cells. At the far periphery early stromal vascularization was evident. With the aid of special staining techniques, a branching septate fungus could be demonstrated throughout the ulcer bed (fig. 3). A few budding spores were also noted, suggesting that the fungus might be a species of Candida. The fungus invaded the corneal stroma deep to the ulcer, but was not found in the purulent exudate within the anterior chamber.

The other changes observed microscopically were those related to the acute endophthalmitis: pus in the anterior and posterior chamber and acute reactive uveitis; and those indicative of the pre-existing chronic glaucoma: atrophy of nerve fibers, loss of ganglion cells, deep excavation of the nerve head, optic atrophy, and so forth (fig. 4).

It was our belief, based on evidence that I will present later, that the extensive acute necrotizing keratomycosis which led to enucleation was probably directly related to the hydrocortisone therapy of this patient's bullous keratopathy.

Summary

Clinical diagnoses. Absolute glaucoma;

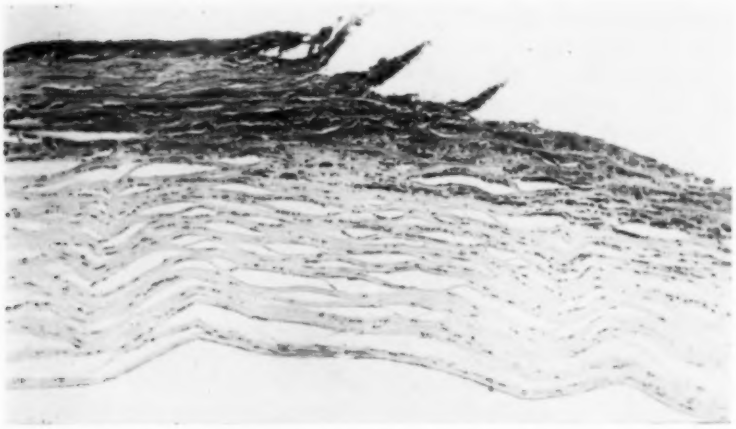

Fig. 2 (Zimmerman and Gibson). *Case 1.* One margin of the ulcer is shown on the left and the ulcer is toward the right. The necrotic stromal fibers of the outer half of the cornea are intensely and diffusely infiltrated by polymorphonuclear leukocytes. The fungi are not apparent in this hematoxylin-eosin stained section. (×115.)

bullous keratopathy; central corneal ulcer of undetermined etiology.

Dr. Gibson's diagnoses. Primary glaucoma; corneal degeneration and bullous keratitis; superinfection of cornea (? Aspergillus); ulcus serpens and hypopyon.

Pathologic diagnoses. Chronic open-angle glaucoma; degenerative keratopathy; acute necrotizing keratomycosis; purulent endophthalmitis.

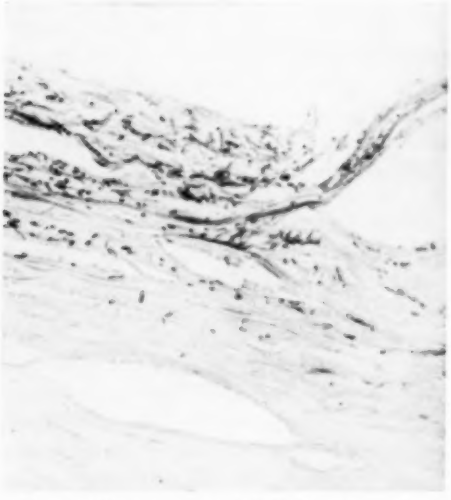

Fig. 3 (Zimmerman and Gibson). *Case 1.* The necrotic corneal stroma is diffusely invaded by a septate mycelial fungus of undetermined species. The intensely stained fungi stand out in sharp contrast to the virtually unstained corneal stroma. (Gomori's methenamine silver stain, ×305.)

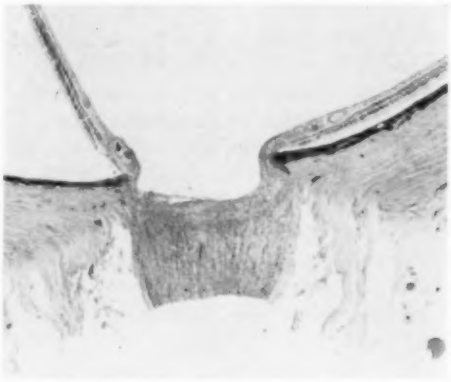

Fig. 4 (Zimmerman and Gibson). *Case 1.* Deep glaucomatous cupping of the optic disc and marked atrophy of the inner retinal layers (Hematoxylin-eosin, ×17.)

Case 2*

Clinical history

A 66-year-old white woman with diabetes

* AFIP Accession No. 687652.

mellitus of many years' duration had repeated vitreous hemorrhages and secondary glaucoma bilaterally. Many cyclodiathermy treatments had been given. A cataractous lens had been extracted from the right eye; the tension of this eye was fairly well controlled. An iridencleisis was performed on the left eye in July, 1953, but the glaucoma was not controlled. Bullous keratopathy developed. It did not respond to treatment with Diamox, sodium chloride ointment, and epinephrine bitartrate jelly. From time to time bullae would rupture and then heal with patching. At first there were no signs of corneal infection.

In December, 1954, she complained of increasingly severe pain in the left eye. Examination revealed slight conjuntival injection and many ruptured bullae. Terramycin ointment to be applied topically three times daily was prescribed. When the patient returned a few weeks later she had an intracorneal abscess in the left eye. She was then put on penicillin and streptomycin ointment, five times daily, and cortisone, twice daily. The abscess became larger and the eye remained painful; enucleation was performed 15 days after the antibiotic and corticosteroid preparations were first prescribed.

Clinical discussion and differential diagnoses

Dr. Gibson. In Case 2, the clinician was dealing with one of the most difficult situations which ophthalmologists encounter. The combined effects of diabetes mellitus and secondary glaucoma make the cornea especially vulnerable to microbial attack. Under these circumstances scrupulous adherence to the principles of judicious therapy is essential. In this patient the early management appears to be acceptable in that an adequate surgical program was instituted by the use of multiple cyclodiathermy procedures. Diamox, sodium chloride ointment, and epinephrine bitartrate are not infrequently effective forms of therapy.

The management of this patient becomes open to inquiry when terramycin ointment was prescribed in the presence of defects in the corneal epithelium, and the eye was permitted to go unobserved for a few weeks. Apparently no effort was made to identify the infecting organism. The choice of an antibiotic was made by chance. If the organism cannot be identified, frequent observations to determine the effectiveness of the antibiotic are necessary. If the immediate response is not favorable, the antibiotics should be changed. The time to treat corneal abscess successfully is early. Antibiotics, locally or systemically, play a very secondary role to surgical management of corneal abscess.

The patient should be hospitalized at once and the diabetic status investigated and corrected as soon as possible. The patient should be operated upon promptly under general anesthesia. Smears and cultures of the lesion should be made, and, if bacteria are present, the proper antibiotic, as determined by sensitivity tests, should be employed. The abscess should be fulgurated with diathermic current. Diathermic ablution of the lesion destroys bacteria and tissue toxins, destroys and removes necrotic tissue which in itself may perpetuate the process. It also destroys the infecting agent and secondary invaders. All organisms are susceptible to diathermic fulguration. It is quicker, more thorough, and more effective than any combination of medicinal agents. Paracentesis should be done at the same time. The clinical course of corneal abscess is almost invariably curtailed by these surgical measures.

Following these surgical procedures, the use of antibiotics and chemotherapeutic agents is in order so that they may exert their bacteriostatic and bactericidal effects on organisms harbored in the conjunctiva or cornea beyond the area of fulguration. Most conspicuous in the mismanagement of this case was the use of cortisone. Cortisone is contraindicated in corneal infection. The present wave of antibiotics and steroid mixtures placed on the market by drug houses

and their widespread use by clinicians are open to question. Admittedly many patients do well in spite of the injudicious use of steroids in infection. Cortisone and its chemical cousins should be used only when there is a specific indication. The inadvisability of steroid therapy in herpetic keratitis has been emphasized. Its use in corneal infection by bacteria is equally contraindicated.

Pathology

Dr. Zimmerman. Examination of the enucleated left eye revealed the iridencleisis wound and a subjacent coloboma of the iris. Just nasal to the center of the cornea was a round white opacity which involved all layers. Straight blood vessels extended from the limbus into the superficial cornea toward the central leukoma. The cornea about the periphery contained a grayish infiltrate. Blood was present in the anterior and posterior chambers. Anterior synechias closed the chamber angle. Diathermy puncture scars were present. The vitreous was formed but hazy and the retina was in normal position.

Microscopic examination revealed ulceration of the central cornea and intense leukocytic infiltration of the stroma forming the ulcer bed. Peripherally an inflammatory vascular pannus invaded the cornea. Between the pannus and the ulcer there was bullous separation of the epithelium from Bowman's membrane (fig. 5). In the ulcer crater and within the adjacent corneal stroma, many yeastlike budding fungi and pseudomycelial forms, consistent with Candida albicans, were found (fig. 6). By special staining techniques a few fungal forms were seen within the sanious exudate contained in the anterior chamber.

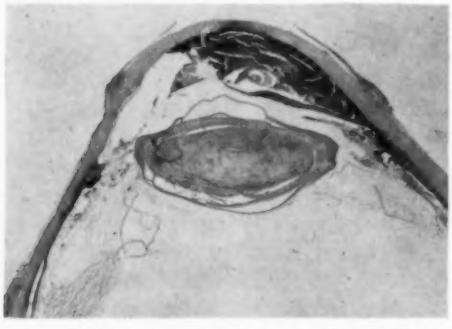

Fig. 5 (Zimmerman and Gibson) *Case 2.* Extensive bullous keratitis and a central corneal ulcer. Bloody pus fills the anterior chamber. The surgical coloboma of the iris is seen on the left. (Hematoxylin-eosin, ×10.)

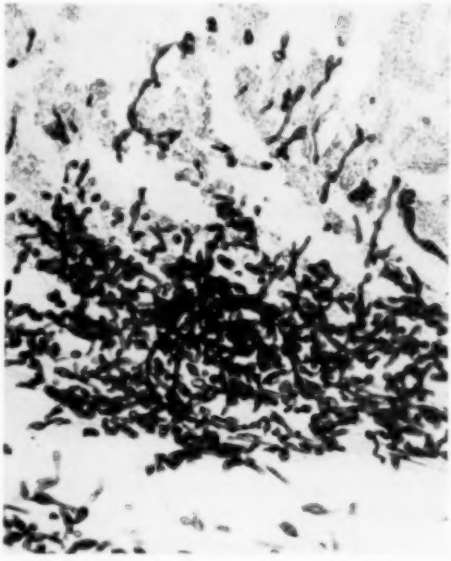

Fig. 6 (Zimmerman and Gibson). *Case 2.* Within the necrotic corneal stroma, innumerable budding yeastlike fungi form from a pseudomycelium that is highly characteristic of a species of Candida. (Gridley fungus stain, ×350.)

The other changes observed were related to the diabetic iridopathy and secondary glaucoma.

Summary

Clinical diagnoses. Absolute glaucoma; abscess of cornea; diabetes.

Dr. Gibson's diagnoses. Diabetes mellitus; secondary glaucoma; corneal abscess.

Pathologic diagnoses. Diabetic iridopathy; secondary glaucoma; bullous keratopathy; acute necrotizing keratomycosis; hypopyon.

Discussion

Dr. Zimmerman. These two cases of keratomycosis were selected for this conference primarily to bring to your attention the growing importance of fungus infections.[1-3] Formerly, mycotic diseases of the cornea were extremely rare causes of hypopyon ulcer necessitating enucleation. We are seeing many more such cases since the advent of antibiotic and corticosteroid therapy. The rising incidence of keratomycosis reported by Haggerty and Zimmerman[2] in the Registry material is shown in Table 1. Although there is already a considerable literature dealing with the general increase in both superficial and deep mycoses observed during the past decade, very little has been published on ocular mycoses. According to Ley and Sanders,[3] the development of a fungus infection of the cornea in a patient receiving topical corticosteroid therapy for another ocular disease was first mentioned by Thygeson and his co-workers.[4,5] Subsequently, Mitsui and Hanabusa[6] described four cases in which mycotic keratitis developed following corticosteroid therapy for a miscellany of ocular conditions. Their cases were recognized clinically and apparently the eyes were salvaged. Ley and Sanders reported three cases which were not recognized clinically or after "routine" pathologic examination. It was only after special staining by the periodic acid-Schiff reaction that their mycotic nature was appreciated. Ley and Sanders were particularly impressed by the similarity of their three cases. Each concerned a farmer who sustained a trivial injury to the cornea.

TABLE 1*

Cases of keratomycosis in the Registry of Ophthalmic Pathology

Period	Number of Cases	Incidence†
1933–1951	3	1:11,329
1952–1956	13	1:777

* From Haggerty and Zimmerman.[2]
† Based on total cases received in the Registry during time interval indicated.

TABLE 2*

Ocular lesions upon which mycotic keratitis was superimposed

	No. Cases
Corneal trauma	8
by vegetable matter	3
by wire while bailing hay	1
by granite dust	1
by foreign body (? type)	1
by cigar ashes	1
by hot sparks	1
Corneal ulcers	5
exposure keratitis (facial paralysis)	1
Mooren's ulcer and glaucoma	1
serpiginous ulcer	1
central ulcer	2
Glaucoma with bullous keratopathy	2
No history received	1

* From Haggerty and Zimmerman[2]

In each case, treatment consisted of corticosteroids and antibiotics, but in spite of this "modern therapy" a progressive corneal infection developed and the eye had to be enucleated.

Assuming that there was an etiologic relationship between the therapy given and the resultant infection in these cases, Ley[7] set out to reproduce the sequence of events in laboratory animals, and he succeeded. He found that cortisone enhanced the pathogenicity of several species of ordinarily saprophytic fungi. He also found that oxytetracycline potentiated Candida albicans infection of the immature rabbit cornea.[7] This is of especial interest to us in consideration of our second case. You will recall that this patient sustained her corneal infection only after being treated with terramycin. Recent work in our own laboratories has added further support to the contention that cortisone therapy is contraindicated in fungus infections of the cornea.[8]

While Ley and Sanders[3] were impressed by the similarity of their three cases, we have seen keratomycosis developing under a variety of circumstances (table 2). In the two cases selected for this conference, the soil upon which the infection developed was that of chronic glaucoma with bullous keratopathy. The common denominators in our

experience are (a) a defect in the corneal epithelium (traumatic, ulcerative, bullous, and so forth) and (b) prolonged therapy with corticoids and/or antibiotics.

It has been our impression that Candida species are not the most frequent causes of keratomycosis, but, unfortunately, in only one case was the fungus cultured. In all others the organism, discovered only after histopathologic study, was believed to be more consistent morphologically with Aspergillus or Cephalosporium. Recently Dr. Thygeson told me that since their first case of mycotic keratitis, already cited,[4] he and Dr. Kimura[9] have studied about a dozen others. In their experience Candida albicans has been the most common causative agent, although they have also had three cases due to Nocardia, one to Cephalosporium, and two to Aspergillus species.

Finally, brief comment should be made about treatment. Dr. Gibson has already made appropriate comments about the "shotgun" therapy used in the two cases selected for this conference. Before judicious treatment can be administered in infectious diseases, the causative agent responsible for the infection must be known. Hence, efforts to establish an etiologic diagnosis must precede therapy. In the case of keratitis, direct examination and culture of corneal scrapings are required. I do not believe it is possible to distinguish mycotic keratitis from bacterial infections on clinical grounds alone. Smears and cultures prepared from exudate removed from the surface of the cornea and conjunctiva will frequently reveal nothing. Scrapings are needed, since the fungi are often deep within the corneal stroma, not merely growing on the surface as in thrush.

Once an etiologic diagnosis of mycotic keratitis is established it becomes imperative to stop all corticosteroids and "broad spectrum" antibiotics. Dr. Gibson has emphasized the value of deep diathermy fulguration of corneal ulcer. Some ophthalmic surgeons have tried lamellar keratectomy with transplant, apparently with success, though others have not succeeded in controlling the infection by such measures.

There is one antifungal antibiotic now on the market, mycostatin (Squibb's Nystatin) that has proved extremely valuable in the treatment of Candida infections of the skin and mucous membranes, but it is so poorly absorbed that it is not useful for systemic administration. We have found several strains of Aspergillus fumigatus to be moderately sensitive to mycostatin. Although work is currently in progress in our laboratories, we are not yet far enough along to state whether this antifungal agent will be of prophylactic and therapeutic value in keratomycosis.

In summary, I want to repeat the warning that has already been made many times by many persons, that the modern wonder drugs will not cure everything and are not without potential danger. They are not a substitute for, but only an adjunct to, a good history, a careful examination, appropriate laboratory studies, and conventional surgical therapy.

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MALIGNANT MELANOMA OF THE CILIARY BODY*

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Malignant melanomas of the ciliary body are relatively infrequent as compared to malignant melanomas of the choroid. Duke-Elder, referring to all malignant melanomas of the uveal tract, noted them to be rare, occurring in from 0.02 to 0.06 percent of all eye patients, or in other words about two to six per 10,000 patients.[1] He states that 85 percent occur in the choroid, nine percent in the ciliary body, and six percent in the iris. This difference in frequency is probably explained by the fact that the choroid has a greater area. For this reason it contains more nerves and melanocytes.

Because of their location, ciliary-body melanomas produce glaucoma earlier than do choroidal melanomas. Conversely, they cause retinal detachment much later. Reduction of vision in such tumors is usually due to encroachment on other structures in the anterior segment, while those in the choroid produce visual changes by causing retinal detachment.

The English literature presents little information correlating clinical and pathologic findings in malignant melanomas of the ciliary body. To make such a correlation, we reviewed 25 specimens received by the Eye Pathology Laboratory of the University of California School of Medicine between 1941 and 1955.

MATERIAL

Eight of the 25 eyes were examined between 1941 and 1949, and 17 between 1950 and 1956. Clinical information and a follow-up on each patient was requested from the physicians who had submitted specimens. The series is too small to permit a statistical evaluation as to age, sex incidence, and prognosis. It is interesting, however, to note that the findings compare closely with those series in which statistical studies could be made (table 1).

Thirteen were right and 12 left eyes, supporting Duke-Elder's contention[1] that there is no statistical evidence for the often-stated belief that the left is more commonly affected. Twelve of the 25 eyes were from women and 13 from men. Callender, Wilder, and Ash[2] noted a slight preponderance of males over females in their study of 500 melanomas of the choroid and ciliary body. All 25 patients were Caucasians.

The ages of the patients at the time of enucleation varied between 32 and 77 years. The mean was 58 years, 18 of the group being in the sixth and seventh decades—slightly older than the published statistics of the combined frequency of malignant melanomas of the ciliary body and choroid, which place the greatest incidence in the fifth and sixth decades.[3]

* From the E. S. Heller Laboratories, Department of Ophthalmology, University of California School of Medicine, San Francisco 22, California. Presented before the Western Section of the Association for Research in Ophthalmology, San Francisco, January 29, 1957.

TABLE 1

SEX, LOCATION, AND AGE DISTRIBUTION OF 25 MALIGNANT MELANOMAS OF THE CILIARY BODY

Side		Sex		Age Distribution (yr.)				Position of the Tumor			
OD	OS	M	F	0–20	21–40	41–60	60 & over	Nasal	Temporal	Above	Below
13	12	13	12	0	1	17	7	10 4 upper nasal; 2 lower nasal	5 2 upper temporal; 1 lower temporal	2	8

PATHOLOGY

Melanomas in the uveal tract are the most frequent malignant tumors of the eye, and, as such, a knowledge of their pathologic characteristics is essential. In the ciliary body the histologic appearance is the same as in the choroid. The cellular structure follows the same pattern—the predominant cell may be spindle-shaped, with or without nucleoli, epithelioid, fascicular, or a mixture of these cells. Reticulum content varies, as in the choroid. Pigment content may vary from zero to a densely pigmented tumor.

Because of their location, ciliary-body melanomas give rise to certain changes in the course of growth and extension which make the clinical course unique. They may spread by blood-stream metastases, or by local invasion of surrounding structures. Local invasion may occur in one or all of four routes:

1. *Anteriorly*, they may spread to involve the iris root, either by direct infiltration or by central displacement of the iris at the root, producing the appearance of iridodialysis (fig. 1). Direct extension along the major arterial circle occurs in melanomas of either the ciliary body or iris, producing the rare ring melanomas (fig. 2). Further anterior extension involves the angle, obliterating the trabecular interspaces and Schlemm's canal, resulting in glaucoma. With further progression, the iris and anterior chamber are involved. Such extremes are rarely seen, however, for the visual disturbances, glaucoma, or a change of iris color lead to diagnosis and enucleation at a much earlier stage.

2. *Central extension* of the tumor results in invasion of the posterior chamber and vitreous. Direct pressure on the lens results in luxation and cataract formation. The pressure point is usually at the lens equator, and causes absorption of lens cortex and posterior extension of the subcapsular epithelium (fig. 3). While the opacity is at first restricted to the portion of the lens next to the point of contact with the tumor, eventually complete lens opacification occurs.

3. *Posterior extension* is relatively late

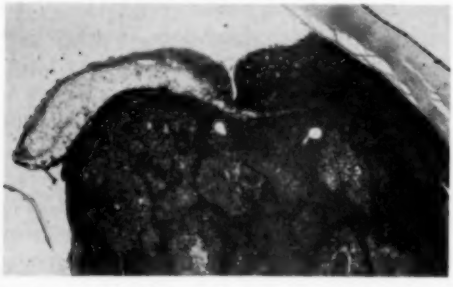

Fig. 1 (Hopkins and Carriker). Iridodialysis caused by extension of the tumor anteriorly, displacing the iris centrally.

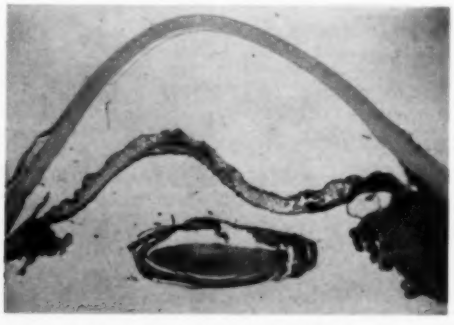

Fig. 2 (Hopkins and Carriker). Ring melanoma, caused by extension of the tumor along the major iris arterial circle.

in the course of these tumors, except for those few that arise in the posterior portion of the pars plana. The ora serrata becomes involved as does the choroid beyond, causing a solid detachment of the retina, giving the exact appearance of melanoma of the choroid (fig. 4).

4. *Extrabulbar extension* often occurs along the scleral emissaria of the ciliary nerves and vessels, and frequently the episcleral pigmented tumor is the first sign noted by the patient. In one case, epibulbar extension was massive, and almost exclusive to extension in any other direction (fig. 5). The prognosis for life expectancy is said to be particularly poor in epibulbar extension of malignant melanoma of the choroid or ciliary body.

Glaucoma

Glaucoma is often secondary to these tumors because of their proximity to the angle. Obstruction of aqueous outflow can occur in the course of extension of ciliary body melanomas by three methods or a combination of them (fig. 6):

1. Pressure of the tumor against the iris root, forcing it against the trabecular meshwork, results in a mechanical obstruction to the outflow of aqueous and resultant glaucoma (fig. 6-A). This mechanism usually does not occur alone, but more commonly in conjunction with

2. Direct invasion of the trabeculas and Schlemm's canal. This is by far the most common cause of glaucoma in these tumors. As the tumor extends to the iris root, it infiltrates the angle structures producing intractable elevation of intraocular pressure (fig. 6-B).

3. A less common mechanism of glaucoma in these tumors is that of central ex-

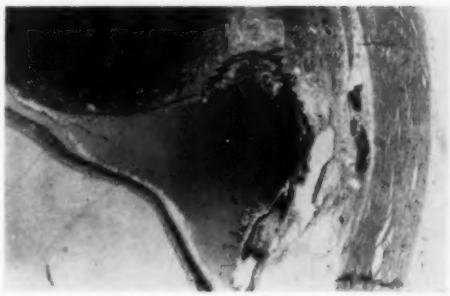

Fig. 4 (Hopkins and Carriker). Posterior extension of the malignant melanoma of the ciliary body, causing retinal detachment.

Fig. 3 (Hopkins and Carriker). Central extension of malignant melanoma of the ciliary body, causing subluxation and degenerative lens changes.

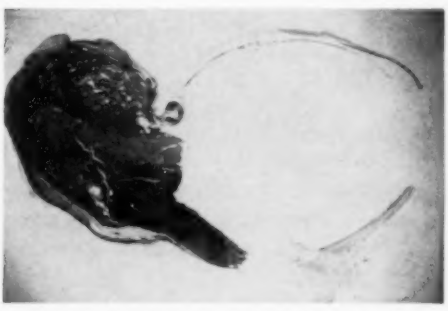

Fig. 5 (Hopkins and Carriker). Massive epibulbar extension in malignant melanoma of the ciliary body.

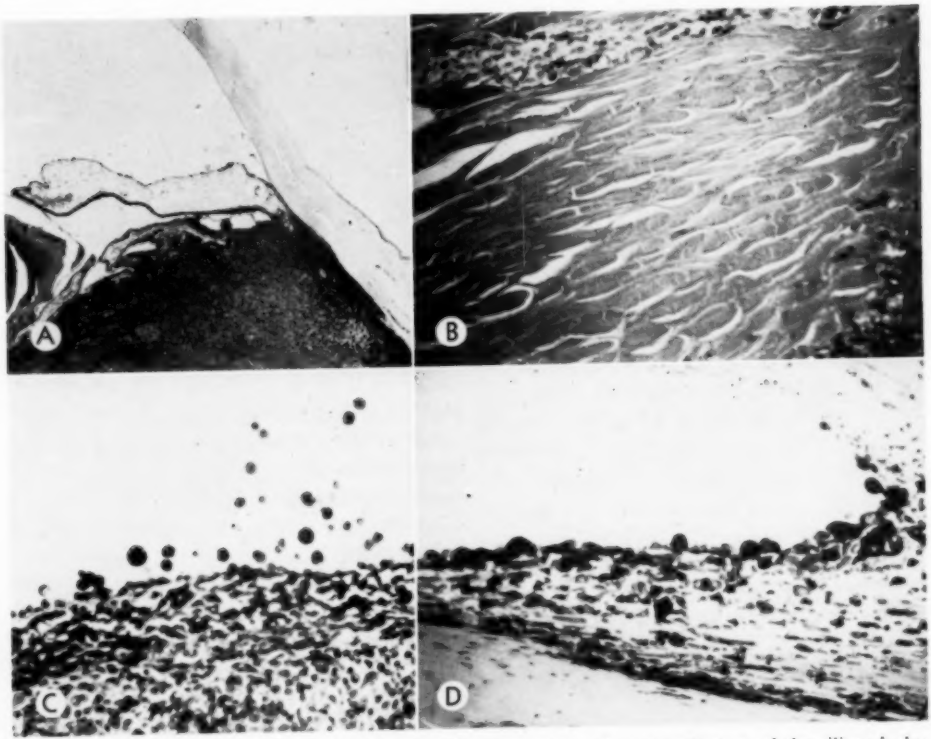

Fig. 6 (Hopkins and Carriker). Mechanisms of glaucoma in malignant malanoma of the ciliary body: (A) Compression of the iris root by the tumor. (B) Direct invasion of Schlemm's canal. (C) Exfoliation of tumor cells in the posterior chamber, which get into the aqueous circulation and are carried to the angle of the anterior chamber (D) where they cause obstruction to aqueous outflow.

tension of the neoplasm to the posterior chamber, where tumor cells exfoliate and get into the aqueous circulation. Carried by the aqueous to the chamber angle, the cells cling to the trabecular meshwork, causing a decrease in the facility of aqueous outflow, and thus glaucoma (fig. 6-C andD).

Clinical findings

Subjective

Melanomas of the ciliary body are most often found incidental to examination of the eye for other causes, particularly a refractive error; but are occasionally brought to the examiner's attention by a specific complaint on the part of the patient, such as a dark or fleshy lesion on the iris or sclera. This is often noted either by the patient or a friend.

They are occasionally found in eyes enucleated for blindness or pain; or at times following surgery for cataract or intractable glaucoma.

Blurring of vision, particularly with accommodative effort, frequently is the first symptom. This is due to pressure of the tumor on the lens, causing subluxation with cataract. At times it is due to a local effect on the ciliary muscle.

Pain is infrequent, occurring only in those patients where the tumor has caused glaucoma. Other visual disturbances such as flashes of light or the ability of the patient to see a shadow are found.

These tumors most commonly are en-

TABLE 2

CLINICAL FINDINGS IN 25 CASES OF MALIGNANT MELANOMA OF THE CILIARY BODY

Case	Eye	Complaint	Injury	Pain	Corrected Vision	Tension (mm. Hg) (Schiøtz)	Anterior Segment Extension	Cataract	Retinal Detachment	Transillumination
1	OD	Blurred vision	No	Yes	20/70	*	+	0	0	*
2	OD	Pain, poor vision	Yes	Yes	LP	36	+	+	*	+
3	OS	Dark spot on iris	No	No	20/20	40	+	0	0	+
4	OD	Blurred vision	No	No	20/300	14	0	0	+	+
5	OD	Brown spot on iris; blurred vision	No	*	*	*	+	+	0	*
6	OS	Black growth on eye	No	Yes	Blind	50	+	+	+	+
7	OD	Impaired vision	No	*	LP	*	+	+	0	*
8	OD	Shadow & flickering lights upper field	No	Yes	20/40	Normal	+	0	+	+
9	OS	Flashing light in temporal field	No	No	20/20	Normal	0	0	+	+
10	OS	None on record	No	*	*	Elevated	+	+	0	*
11	OD	Iris darker color	No	No	20/50	50	+	0	0	0
12	OD	Inflammation & redness	No	No	*	36	+	+	0	*
13	OS	Poor vision	No	Yes	LP	72	0	+	+	0
14	OD	Blurred vision	No	No	*	Normal	+	0	0	+
15	OS	Blurred vision	No	No	20/40	Normal	+	+	0	*
16	OS	Poor vision	No	No	20/300	39	+	+	+	+
17	OD	Blurred vision	No	*	*	Normal	+	0	+	*
18	OD	Decreased vision	No	No	20/200	Normal	0	0	+	+
19	OS	Pain, inflammation, poor vision	No	Yes	LP	45	+	+	+	?
20	OS	Pain, poor vision	No	Yes	LP	80+	+	0	0	+
21	OS	No complaints	No	No	20/40	Normal	+	0	0	+
22	OS	Blurred vision	No	No	20/70	18	0	0	+	0
23	OD	No complaints	No	No	20/40	Normal	+	0	0	*
24	OS	Blurring, diplopia	No	No	20/70	Normal	0	0	0	*
25	OD	No complaints	No	No	*	Normal	+	+	0	+

* Not recorded on clinical record.

Case 6 had been diagnosed two years prior to enucleation, but refused surgery until the eye became blind and painful. In Case 7 the tumor was found following cataract extraction. The tumor could not be seen clinically in Eye 13 but the eye was removed for absolute glaucoma. P^{32} uptake studies were strongly positive in Case 17. Case 19 came to enucleation after unsuccessful trephination for intractable glaucoma, and Case 20 after discovery of the tumor following iridectomy for glaucoma.

countered in patients with no specific complaints referable to the tumor (table 2). When specific symptoms occur, they are due to a change in accommodative power, or a visible tumor on the sclera or iris.

A history of trauma is rare; however, in a significant percentage, injury occurred prior to the discovery of the tumor. In one patient of this series, an injury caused permanent ocular damage several years prior to discovery of the tumor. The injury had most likely caused a pre-existing nevus (benign melanoma), to become malignant because of prolonged inflammation.

OBJECTIVE

Except in rare cases with far-advanced tumor, or in those where the tumor is found as a sequel of cataract or glaucoma surgery, the visual loss in these patients is ordinarily not great (table 2). Most often the tumor is discovered early. Many have a corrected acuity close to normal. When reduction in vision has occurred, it is usually found to be 20/40 to 20/70. Degenerative lens change, accommodation loss, and increase in lenticular astigmatism occur. Extension of the tumor to the choroid results in retinal detachment and coincidental field change.

Some small tumors are recognized during examination as pigmented growths projecting over the edge of the pupil when it is widely dilated. More often, the iris adjacent to the tumor is elevated, causing the anterior

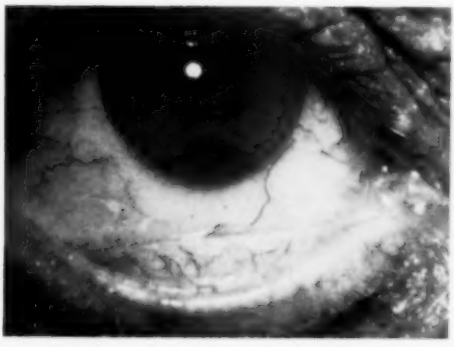

Fig. 7 (Hopkins and Carriker). Anterior extension of malignant melanoma of the ciliary body. A dark tumor mass can be seen invading the anterior chamber with characteristic flattening of the pupil adjacent to the tumor.

chamber to be shallow. If anterior extension occurs, the tumor encroaches on the angle, distorting the iris (fig. 7) and obstructing the angle structures, causing glaucoma. Rarely, the recalcitrant glaucoma so produced is attacked surgically to produce relief, and the tumor found at surgery. One case in this series was discovered following such a procedure.

Change in iris color occurs in two ways: (1) iris freckles often deepen in color when a melanoma is present within the globe[4] (fig. 8) and (2) the iris takes on a deeper color when anterior extension of a pigmented melanoma occurs. Should the tumor contain little or no pigment, the extension may appear as a light-colored lesion in the anterior chamber. In one case of our series, the tumor became necrotic, causing an iridocyclitis. The combination of a pale lesion and iridocyclitis led to an erroneous diagnosis of tuberculoma for a short time before the true diagnosis was apparent and enucleation performed (fig. 9-A and B).

Maximal dilatation of the pupil is necessary to see early lens changes as they occur at the equator of the lens first. Subluxation ordinarily is so slight that it is not noted. It may give rise to an increase in lenticular astigmatism. In one patient, an increase of 1.0D. of astigmatism was noted over a four-month period.

Fig. 8 (Hopkins and Carriker). Iris freckle, showing increase in pigment content in the presence of intraocular malignant melanoma.

When epibulbar extension occurs along the emissaria of the ciliary nerves and vessels a dark lesion on the sclera is often the first complaint (fig. 10).

Extension may occur along the course of the greater iris arterial circle, producing a ring melanoma. Gonioscopy is of value in the diagnosis of ring melanoma in that a generalized increase in pigmentation in the angle occurs. Early glaucoma is common in this type of tumor.

The presence of the tumor in the ciliary body at first causes a reduced intraocular pressure in many cases as compared with the fellow eye. The cause of this phenomenon is not known. It is known to occur in choroidal melanomas, possibly due to involvement of the nerve supply to the ciliary body. Glaucoma occurs later as the iris is compressed against the trabeculas by the growing tumor, or as it infiltrates the trabeculas and/or Schlemm's canal.

Gonioscopy is of value for detection of early anterior extension of malignant melanomas of the ciliary body. Pigmentation of the ciliary portion of the angle can be seen just behind the scleral spur.

These subjective and objective observations usually lead to the diagnosis. In addition, transillumination of the tumor often is positive. Cysts of the nonpigmented epithelium of the ciliary body may also occur with these tumors (fig. 11). These cysts occasionally cause confusion in transillumination and

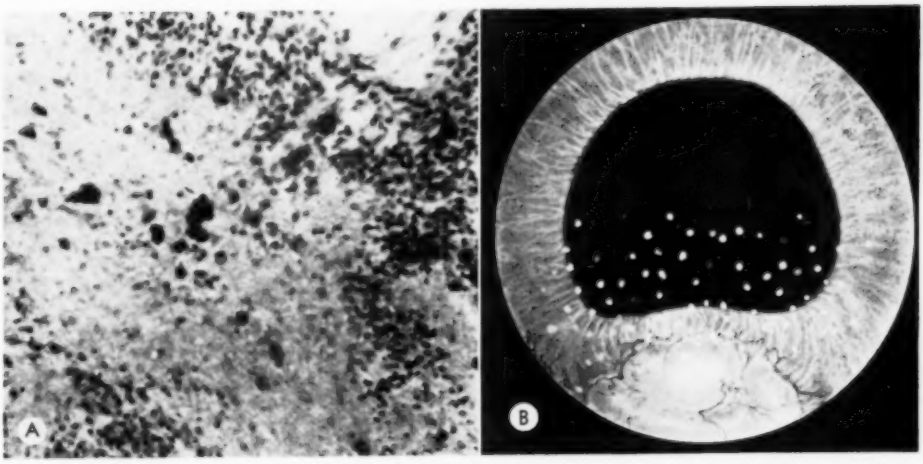

Fig. 9 (Hopkins and Carriker). Necrosis of a malignant melanoma of the ciliary body: (A) Histopathologic appearance of the necrotic tumor. (B) Clinical appearance, with anterior chamber extension. The tumor contained minimal pigment, and tumor cells on the posterior surface of the cornea resembled keratic precipitates, leading to an initial erroneous diagnosis of tuberculoma of the iris.

therefore when negative it may not necessarily rule out the presence of tumor. Transillumination is of greatest value when found to be positive.

With the recent advances in the use of radio-isotopes in tumor diagnosis, radioactive phosphorus (P^{32}) being a pure beta-ray emitter has been used with comparatively safety and success in the diagnosis of intraocular tumors of the anterior segment. It is not of great value in tumors posterior to the equator of the eye.

Prognosis

Callender and Wilder have studied 500 melanomas of the choroid and ciliary body, classified them according to cell type, and based the prognosis on dominant cell type.[2] Reticulum content has also been determined in an effort to prognosticate these tumors. The cell type, argyrophile content, and pigment content in ciliary body melanomas vary as they do in choroidal melanomas.

Prognosis cannot be based on this series for two reasons: First, the series is small, and, secondly, the survival time of many of these patients has not been for a sufficient length of time on which to base a prognosis. Nevertheless, of the five eyes enucleated over 10 years ago, there has been a 60-percent survival for the 10-year period, all of the group surviving for over five years. In that group of six eyes enucleated less than 10 years, but more than five years ago, five of the six have survived, no record being obtainable on the other case. It would seem from this small series that the prognosis over-all is somewhat better than that of choroidal melanomas and worse than iris

Fig. 10 (Hopkins and Carriker). Extrabulbar extension of malignant melanoma of the ciliary body. The dilated vessels associated with the tumor are a constant finding with this type of extension.

Fig. 11 (Hopkins and Carriker). Ciliary cysts in conjunction with malignant melanoma of the ciliary body.

melanomas; however, a study of a far greater number of these cases would be necessary to establish such an outlook.

Summary

Twenty-five eyes studied at the Eye Pathology Laboratory of the University of California between 1941 and 1956 with malignant melanoma of the ciliary body are reviewed, and their clinical signs and symptoms correlated with the pathologic findings. The series is too small to serve as a basis for prognosis which would appear to be somewhat better than in choroidal melanomas.

1. Malignant melanomas of the ciliary body have the same histologic characteristics as do those in the choroid, but the clinical signs and symptoms, particularly in the early stages, vary because of the anatomic location of the tumor.

2. Visual disturbances are based on the method of extension of the tumor. In central extension of the tumor with lens involvement, lenticular astigmatism and cataract may occur. Decrease in accommodation due to ciliary muscle involvement is the rule. If the tumor extends posteriorly, retinal detachment occurs, with its attendant symptoms.

3. Local extension of the tumor is by one of four routes: (a) centrally, involving the lens, posterior chamber and vitreous; (b) anteriorly, invading the iris and chamber angle; (c) posteriorly, invading the choroid; and (d) via the ciliary emissaria, resulting in extrabulbar extension.

4. Glaucoma may occur from: (a) posterior compression of the iris root by the tumor, causing angle blockage; (b) direct invasion of the trabeculas and Schlemm's canal; and (c) exfoliation of tumor cells in the posterior chamber where they are carried to the trabeculas causing a decrease in the outflow of aqueous.

5. One must be cautious in transillumination that a negative interpretation does not lead to a definite exclusion of melanoma, for co-existing cysts of the ciliary body will occasionally cause transillumination to be interpreted as being negative.

6. Gonioscopy is often of value when the diagnosis is in doubt. If melanoma is present, increased pigmentation of the ciliary portion of the chamber angle may often be seen.

7. Studies with radioactive phosphorus (P^{32}) may be helpful in the diagnosis of tumor, but the result of the test must be considered an adjunct to clinical diagnosis, and not a final authority for enucleation.

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A STUDY ON DONOR-RECIPIENT SENSITIZATION*

In experimental homologous partial lamellar corneal grafts

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An important problem in corneal grafting is the late clouding that sometimes occurs in otherwise successful grafts (maladie du greffon). It is possible to produce experimentally a similiar type of opacification of partial penetrating corneal grafts in rabbits. This has been achieved by implanting subcutaneously into a rabbit with a corneal graft a piece of skin from the donor two weeks after transplantation.[1] The present study was undertaken to see if, in the case of lamellar grafts, donor-recipient sensitization might affect the clarity of the corneal grafts in rabbits.

Methods

Rabbits from various stocks weighing about two kg. were used. They were operated in pairs and the corneal discs, cut with a Franceschetti trephine, were exchanged. The lamellar discs were 7.1 mm. in diameter and from one half to two thirds of the corneal thickness. They were put eccentrically near the limbus of the recipient cornea to facilitate the invasion of blood vessels. Details of the surgical technique are to be found in a previous paper.[2]

With the improved surgical technique, clear lamellar grafts were obtained in 55 percent of 52 grafted eyes. All the lamellar grafts which were clear for seven to 10 days postoperatively remained clear throughout the whole period of observation which in some cases was as long as seven months. On slitlamp examination there were a number of blood vessels in all the corneas of the recipients which reached the edges of the graft by the seventh postoperative day.

Histologic examinations of these lamellar grafts performed from 12 hours up to seven months after transplantation showed that the epithelium of the grafts survived, that the stromal fibers were not replaced, and that

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most of the stromal cells persisted for varying lengths of time after operation.

The donor sensitization experiments were performed as described by Maumenee and co-workers in their study on partial perforating grafts.[1] Pieces of skin from the abdomen measuring 2.0 by 2.0 cm. were taken from the donor rabbit from which the corneal discs were cut and put into a pocketflap under the panniculus carnosus of the abdominal wall of the recipient animal.

Results

Of 34 eyes which were grafted seven to 14 days after skin implantation, 41 percent gave clear grafts. Of 19 eyes grafted at the same time as skin was implanted, 47 percent showed clear grafts. In 10 eyes, each with a clear graft transplanted two weeks before skin implantation, all the grafts remained clear.

In order to augment the amount of antigen transferred, a lamellar corneal disc was obtained from the same donor from which cornea and skin had been previously taken and grafted onto the other eye of the recipient from one to two weeks after the first eye had been grafted. In 25 rabbits treated in this way, 46 percent out of the 50 corneal grafts remained clear.

In two of these animals grafts which had taken successfully and had remained clear for a number of days suddenly became cloudy. In one of these rabbits cloudiness, accompanied by invasion of blood vessels, appeared in the first grafted eye 16 days after the initial corneal and skin grafts and seven days after the second corneal graft. Three days later the second eye showed the same clinical picture as the first. During the next two days, both corneas became completely opaque. The recipient's own cornea showed very little reaction. The iris was not hyperemic and there was no aqueous flare. Death of the animal prevented further observation. The main pathologic changes on histologic examination of both eyes were in the lower two thirds of the graft. There was

Fig. 1 (Kornblueth and Nelken). Lamellar corneal graft which was clear for 18 days before opacification due to sensitization. Lower two thirds of the graft shows edema and infiltration with polymorphonuclear leukocytes, plasma cells, and lymphocytes in addition to invasion by many dilated and congested blood vessels. (Hematoxylin-eosin. ×100.)

marked edema and heavy infiltration with polymorphonuclear leukocytes, plasma cells, and lymphocytes. The stromal cells at the site of infiltration were very scarce and many dilated and congested blood vessels were found in this area (fig. 1). The recipient's cornea adjacent to the graft showed very little reaction.

The second rabbit, which was the donor recipient of the first one, developed sudden opacification of the first graft accompanied by invasion of blood vessels three weeks after the initial corneal and skin grafts and two weeks following the corneal transplantation in the second eye (fig. 2). The latter graft became hazy at the same time as the first one and a small number of blood vessels invaded the graft (fig. 3). Five days later the opacity started to clear and three days later one cornea was completely clear and in the other only slight opacity remained (figs. 4 and 5). Three months later histologic ex-

Fig. 2 (Kornblueth and Nelken). Lamellar corneal graft of right eye which was clear for three weeks, showing opacification due to sensitization.

amination revealed no pathologic findings in either graft.

In two other rabbits, in addition to a corneal and a skin graft, a piece of cornea measuring 2.0 by 2.0 mm. was taken from the same donor and inserted through a limbal incision into the anterior chamber of an eye which had had a clear corneal graft for two weeks after operation. The clarity of these grafts was not influenced by this procedure.

Discussion

Many factors other than experimental sensitization may be responsible for opacification of corneal grafts during the first two weeks following the operation. Thus the percentage of successful lamellar corneal grafts with an improved technique in a group of nonsensitized rabbits was only 55 percent. Sensitization with donor skin before or at the time of corneal transplantation did not significantly lower the percentage of clear takes. Furthermore, in animals with clear corneal grafts, sensitization with skin did not cause opacification of the grafts. Increasing the antigenic dose by a second corneal graft was followed only occasionally by temporary late clouding.

These results indicate that the induction of opacification in lamellar corneal grafts by

Fig. 4 (Kornblueth and Nelken). Same lamellar corneal graft as in Figure 2, eight days later. Graft much clearer, showing slight haze.

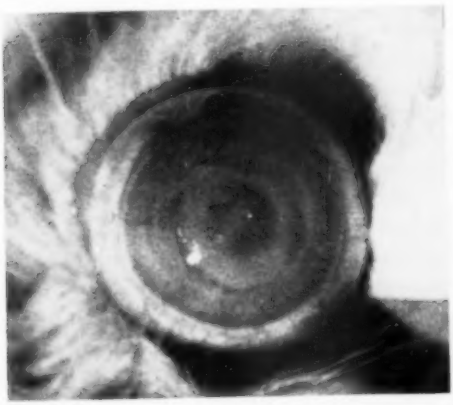

Fig. 3 (Kornblueth and Nelken). Lamellar corneal graft of left eye of same rabbit as in Figure 2 which was clear for two weeks showing opacification due to sensitization.

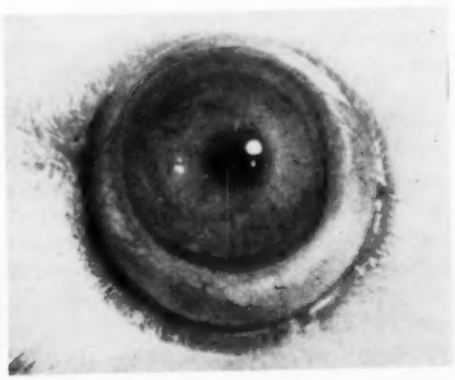

Fig. 5 (Kornblueth and Nelken). Same lamellar corneal graft as in Figure 3, eight days later. Graft completely clear.

donor-recipient sensitization was less successful than in the case of the perforating type of corneal graft. It might appear that the amount of corneal tissue used in a lamellar graft is less than that in a 4.5-mm. perforating graft. However, a 7.1-mm. lamellar corneal disc of half the thickness of the cornea actually comprises about 25 percent more corneal material than a 4.5-mm. perforating graft. In addition, the corneal epithelium which has been shown to elicit an immune reaction[3] is preserved in a lamellar graft, but is replaced by the epithelium of the recipient in a perforating graft.

It is difficult to compare the experiments described above with lamellar keratoplasty in man. In our experiments lamellar grafts were put into avascular normal corneas and in addition skin was also implanted, while in man lamellar keratoplasty is performed on vascular and cloudy corneas and no skin is implanted. However, the clinical impression is that late clouding of originally clear grafts in man is less frequent in the case of lamellar than in perforating corneal grafts.

Very few statistical data on this subject are available. Paufique[4] observed that if a lamellar graft had remained clear for one month following opertion it usually remained transparent indefinitely. Rycroft and Romanes[5] reported that 16 percent of 62 cases of partial lamellar keratoplasty showed severe vascularity of the graft which they ascribed to an antigen reaction between donor graft and host cornea. Bushmich[6] described delayed opacification of originally clear grafts appearing three weeks postoperatively in 23 percent out of 418 cases of partial penetrating keratoplasty.

One of the reasons for the lower percentage of late clouding of lamellar grafts in both animals and in man may be the lack of contact between the donor cornea and the aqueous humor of the anterior chamber. In cases of uveitis the aqueous humor has been shown to be an important site of antibody formation.[7] In perforating grafts, the aqueous humor directly bathes the donor material which might result in the transfer of antibodies to the donor cornea by the aqueous humor. These antibodies, by the same token, are in direct contact with the antigen. This anatomic facilitation of an antigen-antibody reaction in the donor cornea may explain why perforating heterografts usually become cloudy while lamellar heterografts tend sometimes to remain clear.[8]

The sudden onset of late clouding of corneal grafts is often accompanied by marked dilation of the vessels of the iris and the appearance of a positive flare in the aqueous humor. Clinical and histologic examination of the homologous partial perforating transplants which develop delayed clouding show damage or loss of the corneal endothelium. The way is then open for infiltration of the graft by the antigen-containing aqueous, which might be the cause of the virulent inflammatory reaction that often occurs. On the other hand, in a lamellar graft the aqueous humor is separated from the antigen in the donor cornea by the remaining layers of the recipient cornea. This barrier may inhibit antibody formation in the aqueous and even if some antibodies were formed by the aqueous from absorbed antigen, they would not be in direct contact with the graft.

Summary

Induction of opacification of homologous partial lamellar grafts in rabbit cornea was attempted by donor-recipient sensitization.

Implantation of skin in addition to corneal transplantation did not usually cause clouding in originally clear grafts. This finding is in contrast to the very high percentage of opacifications produced in experimental partial perforating homologous corneal grafts by donor-recipient sensitization.

A possible explanation for this reduced incidence of clouding might be the lack of contact between the aqueous, a site of antibody formation, and the donor cornea.

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A STUDY ON MORTALITY RATES*

DURING GENERAL ANESTHESIA FOR OPHTHALMIC SURGERY

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There has been scant reference in the ophthalmic literature to mortality and morbidity from general anesthesia. Many ophthalmic surgeons and anesthetists belittle the incidence of serious complications and have said there should be no anesthesia problems in a good hospital. However, a survey of the experience of 577 ophthalmologists, who answered our request for such information, demonstrates that there is indeed an anesthesia problem in ophthalmology, that mortality is significant and morbidity is common place, and that these conditions exist in the largest medical centers as well as in smaller institutions.

In August, 1956, a questionnaire was sent to 922 ophthalmologists, for which every fourth name from the list of diplomates in ophthalmology was selected. There were 577 responses. We wish here to express our deep gratitude to our colleagues for their cooperation. The purpose of the questionnaire was to elicit information regarding:

1. Mortality and morbidity resulting from operation under general anesthesia in ophthalmology.

2. Anesthetic agents used and techniques of administration, correlated with mortality and morbidity.

3. Ages of patients at the time of death.

4. The preferred age for strabismus surgery.

During the 10-year period from 1946 to 1956, there were 72 deaths from surgery under general anesthesia reported by the 577 respondents; this extrapolates to 456 deaths among all diplomates over this 10-year period, an average of 45.6 per year (table 1).

Mortalities were reported from the year 1910 to 1956; however, it was decided to use only the figures for the last 10 years as they were more likely to be representative. Furthermore, the deaths reported may well be fewer than those actually occurring, for human nature is such that we tend to forget our painful experiences. It is interesting that the largest number of deaths reported were for 1956, though the answers were almost all received by November 1, 1956, before that year was completed.

There are, without doubt, many more mor-

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TABLE 1

ESTIMATE OF DEATHS BASED ON DEATHS REPORTED

Year	Number of Deaths Reported (577 respondents)	Estimate of Deaths among All 3,688 Diplomates
1947	4	25
1948	6	38
1949	6	38
1950	10	63
1951	6	38
1952	9	57
1953	6	38
1954	8	51
1955	5	32
1956	12	76

talities in the large groups of noncertified ophthalmic surgeons, including practitioners and residents. Thus the average estimated number of 45 deaths per year must be very conservative.

The ages of the patients who died ranged from five months to over 70 years, but the largest numbers of anesthetic deaths were in children up to the age of nine years. This probably parallels the higher incidence of ophthalmic surgery under general anesthesia in this age group. However, there seems to be a lower number of deaths after the age of seven years and still fewer after the age of nine years. Over one half of the total number of deaths reported was in the group below seven years of age.

The respondents who reported mortalities comprised a fair geographic sampling of the entire United States and among them were many ophthalmic surgeons affiliated with large university hospitals.

Morbidity from general anesthesia in ophthalmology is frequent. Minor complications predominate but there were 87 serious complications reported by the 577 respondents over the 10-year period, most of them just short of mortalities. The largest number of these resulted from laryngeal spasm and tracheal edema following intubation. Respiratory and cardiac arrest were noted frequently. Pneumonia, lung abscess, and atelectasis occurred occasionally. Minor complications, such as protracted postoperative vomiting and dehydration, were reported.

Tracheal intubation was the most frequent technique employed for administration of anesthesia, with open drop second and insufflation third. Ether was the most frequent basic anesthetic agent used with these techniques. Rectal and intravenous sodium pentothal were used by a few of the respondents. Mortalities were reported with all of these methods and agents. The method of administration of anesthesia and the anesthetic agent used did not influence mortality within the limits of this study.

Surgeons have a tendency to blame the anesthetists for all the complications. However, we think that problems arise even with the best anesthetist and the best is not always available to us. There is a great need for larger numbers of skilled anesthetists.

The ophthalmic surgeon is rarely able to choose the anesthetist in a given case. In small communities he is limited by the anesthesia personnel available, and in large medical centers he is limited by hospital arrangements. Yet he is morally and legally responsible for anything that happens to his patient.

None of the answers we received mentioned curare as a cause of death. However, we have heard of such cases. Undoubtedly curare is a useful but a dangerous drug to use in ophthalmic anesthesia.

Kirsch[1] et al. recently reported on cardiac arresting reflexes of eye surgery. They pre-

TABLE 2

AGES AT WHICH DEATH OCCURRED

Age (yr.)	Numbers of Deaths
Under 1	6
1–2	2
2–3	6
3–4	8
4–5	9
5–6	10
6–7	9
7–8	3
8–9	4
9–19	3
19–78	11

sented impressive evidence that retrobulbar injection of procaine blocked the oculovagal reflex and thus prevented bradycardia and cardiac arrest during manipulation of the extraocular muscles. General anesthesia does not block this reflex.

While our study did not cover this question, we believe from our experiences and those related by others that the mortality in ophthalmic surgery is far higher with general than local anesthesia.

Beecher and Todd,[2] in a study of 559,538 anesthesias in 10 university hospitals over a five-year period, found one anesthetic death per 1,560 anesthesias. The death rate was reported disproportionately high during the first decade of life.

The ophthalmic surgeon rarely has the problem of an acutely ill and debilitated patient who requires an emergency operation. Most ocular surgery is elective and very many operations on children in apparently good health are for strabismus. Here the rate of mortality is almost unbearably great.

Most of the respondents prefer to operate for strabismus on a child before school age. Many qualified their preferred age for surgery with considerations of whether the squint be convergent of divergent and the status of fusion.

Conclusions

This study was not conducted in a manner that permits valid detailed statistical conclusions. However, it points up the fact that mortality and morbidity are associated with ophthalmic surgery under general anesthesia and that these accidents are not rare. The mortality in ophthalmology is probably greater than most of us realize.

The respondents to our questionnaire constitute a cross-section of American ophthalmology and it was noted that deaths were reported by surgeons affiliated with large university hospitals as well as by surgeons in smaller communities.

1749 Grand Concourse.

2625 Grand Concourse.

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HÔPITAL ALBERT SCHWEITZER, HAITI, WEST INDIES

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In the Arbitonite valley of Haiti some 90 miles north and west of the capital city of Port-au-Prince and adjoining the village of Deschapelles a new modern 75-bed hospital has been built. Thus, the inspiration of the work of Dr. Albert Schweitzer given Dr. William Larimer Mellon, Jr., to study medicine, and his wife, Gwen Grant Mellon, to study laboratory and surgical technique, came to fulfillment. The opening of Hôpital Albert Schweitzer in June, 1956, was a great event in Haiti, especially in the district which it serves, as the people, a quarter million in number, had had but little medical care.

The building is a one-story winged structure of native stone set in concrete, with outer walls of glass jalousies. There are wide overhangs of the roof which protect from the weather as well as cover the pebble and concrete walks that skirt the building. The roofing is of eight-inch reinforced concrete covered with asbestos so that the building is fireproof. The wing, containing two operating rooms, recovery room, emergency room, laboratory, X-ray department, central supply, and morgue, is air-conditioned. The

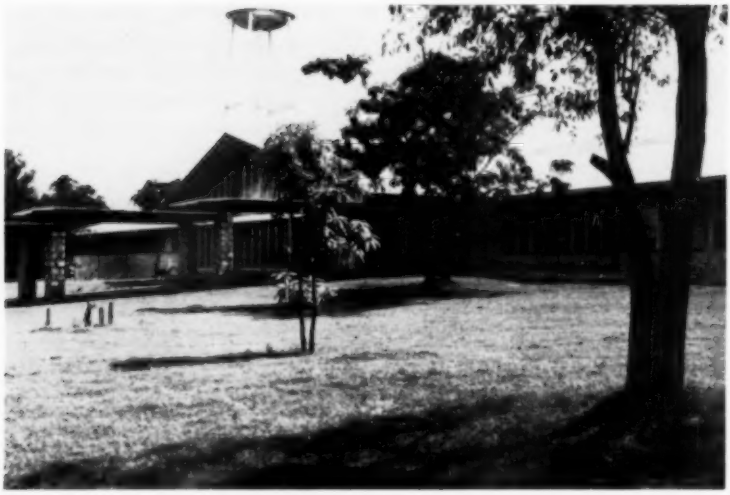

Fig. 1. (Elles). View of surgical ward, with common dining room at extreme left.

compound has its own water supply, electric current, laundry, garage, machine and carpenter shops.

To the right of the hospital on rolling landscaped grounds are some 16 residential cottages which Dr. Mellon has taken over from the Haitian government and which belonged formerly to the Standard Fruit Company. These are used to house members of the staff, who either may keep house or have meals in the community dining hall in the hospital proper.

There are outdoor waiting places for patients and a corral with shelter for the donkeys and lean horses of patients who travel by this means. Many come on foot, often many miles, or by native camions.

The scenery about the hospital compound is beautiful. There are many tropical plants and trees, some of which are always in

Fig. 2 (Elles). Breezeways connecting two wards.

Fig. 3 (Elles). Outdoor waiting place for patients.

bloom. The mountains, the Montagnes Noires range lying to the north and the Chaine Des Matheux to the south, which, in the changing light, may be brilliant in yellow and reddish gold or sinister in dark blue and purple, even black in the shadows, afford never-ending fascination. Often fantastic cloud formations hang over the peaks.

The medical staff consists of six doctors, 18 graduate nurses, three of them French-Canadian nuns, a supervisor of nurses, an X-ray technician, two laboratory technicians, and 20 native auxiliary nurses aids. In addition, doctors with special skills in orthopedics, ophthalmology, plastic surgery, and other specialties have come at times from the University Medical School of Haiti, the United States, and Jamaica to volunteer their services.

The staff is international in character; American, Canadian, Chinese, French, Danish, German, Jamaican, and Haitian. The language of the country is French and many of the educated people speak English. The native people speak a patois called "creole" which is a mixture of French and African with some Spanish and Indian words.

Clinics in all departments are held three days a week and patients arrive long before the hour of opening, 8:00 A.M. Several hun-

Fig. 4 (Elles). Admission desk and indoor waiting room.

Fig. 5 (Elles). Corral for animals of patients.

dred come and wait patiently while the clinic continues until 6:00 P.M. or later. The staff takes an hour for lunch and, during this interval as well as through the waiting hours, the patients may refresh themselves at a native managed "cafeteria" which Dr. Mellon has permitted them to set up under a big tree in front of the hospital. This consists of a few packing boxes made into tables and a few iron cooking pots in which they prepare rice and beans, their staple food. Fresh fruit, bread, sweets, and bottled soft drinks can be had and, at times, articles of clothing are displayed. The inevitable "marchand" always appears.

There is a fee of two gourds (40 cents) charged for the first visit to the clinic if the patient is able to pay. Subsequent visits are one gourd (20 cents) unless the appointment slip given for such visits has been marked "no charge" by the doctor. The patient also pays a small charge for his medicine, if able. Fees for in-patients are regulated according to their ability to pay. Many pay for their first week in hospital but may be in several weeks without further payment. In lieu of fees, patients bring pigs, chickens, eggs, fruit, or vegetables.

The Ophthalmologic Clinic attains the gamut of eye diseases. Predominating are cases of glaucoma and cataract in the older patients and diseases due to faulty nutrition in the children. Many of the acute conjunctival infections are gonorrheal.

One sees few foreign bodies in this agricultural district and, much to my surprise, there was no acute trachoma. A few old trachoma cases appeared but the patients had lived in other places. Most of the adults have pinguecula and pterygium, the latter often quite advanced.

Tuberculosis, which is quite prevalent, involves the eye in but few instances. Old cases of panophthalmitis and endophthalmitis are not uncommon. Patients with uveal tract infection have to be hospitalized to assure proper treatment. Many forms of corneal ulcer are to be seen, especially in children. Strabismus cases are rather rare. There is always a backlog of surgical cases.

The happy patients were those who were refracted and given glasses. Many of them had never before had them. Some who could afford it were sent to opticians in Port-au-Prince with prescriptions. The others were given glasses from a supply which the Episcopal nuns in Port-au-Prince had had sent them from collections of worn glasses made in the United States. These were neutralized and marked so that, as near as possible, a correction could be given. Empty frames were also of use to those who had only enough to pay for lenses.

Almost without exception, the patients complained of mal-de-tête (headache) and told of a "coup a la tête" (blow). They al-

Fig. 6 (Elles). Outdoor "cafeteria" run by Haitians for clinic patients.

ways associated a blow with their eye disease, so one soon learned not to give too much importance to this. Objective examination was the most dependable factor in making a diagnosis.

An interesting problem was that of getting the children brought in for immunization. A jeep equipped with an explanatory tape-recorded speech was sent around the district but only a few children came at the appointed time. So Ti Jean, a Haitian employed in the office to interview patients, took to the road himself visiting market places, schools, and churches. After his first trip and on the first appointed day about 500 children appeared. What a swarm! This was an opportunity to inspect the eyes of the children as they came inside and to find quite a number with eye diseases needing attention. Subsequently Dr. and Mrs. Mellon with others of the staff made trips to remote places in the mountains to urge the people to bring their children for immunization. Adults, too, are coming as they are awakened to the importance of eliminating disease. Much is yet to be done in pioneering education in nutrition and sanitation, and that will come.

The opportuity for service at the Hôpital Albert Schweitzer offers great compensation as a life of fulfillment to dedicated medical people. There have been some volunteer personnel but most of the staff are on salary paid by the Grant Foundation which was set up by Dr. Mellon in the name of his wife, Gwen Grant Mellon. This fund is supplemented by outside contributions in money and kind.

Living in a foreign country and knowing its people while working among them in medicine is truly a broadening and stimulating experience. One is never bored for frequent interesting and amusing incidents occur and one has the great satisfaction in service where it is much needed.

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INTRAOCULAR NEMATODIASIS*

With special reference to Toxocara canis, the dog ascarid, as a causative agent in nematode endophthalmitis

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Although intraocular parasites "occur so rarely that they are legitimately considered as ophthalmologic curiosities" (Duke-Elder[1]), in certain endemic areas of the world these parasites constitute a formidable and serious ophthalmologic problem. For example, the inhabitants of entire native villages have been reported blinded from ocular onchocerciasis.

In the past decade intraocular parasites have been assuming increasing importance in the field of ophthalmic pathology. Recently, the protozoan, Toxoplasma gondii, has been incriminated as the etiologic agent in a startlingly high percentage of cases of granulomatous uveitis. Ridley,[2] writing in Sorsby's text, *Systemic Ophthalmology*, states that Onchocerca volvulus, with the exception of trachoma, is responsible for more loss of sight than any other infection. In her monumental contribution, "Nematode endophthalmitis," Wilder[3] concludes, "that nematodes play an important and hitherto unrecognized role in blindness in children, and particularly in the production of pseudoglioma and Coats' disease in the United States of America."

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The subject of intraocular nematodiasis will be reviewed briefly, thus providing a general background for the introduction of Toxocara canis, the canine ascarid, as a causative agent of nematode endophthalmitis. For more complete consideration of the nematodes, reference is made to standard texts, such as those of Faust[4] and Chitwood.[5] Other metazoan, but unrelated intraocular parasites such as Taenia solium (cysticercus cellulose),[6,7] Echinococcus granulosus,[8,9] and Hypoderma bovis (ophthalmomyiasis interna)[10] will not be considered, although a few pertinent references are given.

Nematodes

The nematodes are unsegmented roundworms, usually cylindrical, but more or less attenuated at their anterior and posterior extremities. A complete digestive tract is present. With very few exceptions the sexes are separate. The male is distinguished by being the smaller. The worms are usually creamy or ivory-yellow in color, and most species are partially transparent in the viable state. In size, adult nematodes vary from filiform objects just visible to the naked eye (Trichinella spiralis) to large, elongated wirelike worms which may attain a length of one and a half meters (Dracunculus medinensis). The life cycles of parasitic nematodes differ widely, from a very simple development to complicated life histories involving one or more intermediate hosts, usually species of insects.

Faust's *Human Helminthology*[4] has been utilized extensively in the preparation of this paper, and his classification has been adopted. The various families of Nematoda will be presented, arbitrarily, in descending order of their ophthalmic importance as parasites and as established, presumptive, and unlikely intraocular pathologic entities. Specific therapy will be discussed only in regard to the nematodes firmly recognized as intraocular parasites.

Part I: Review of Intraocular Nematodiasis

Acanthocheilonematidae (Filarioidea)

Onchocerca volvulus. Without question, O. volvulus is the most destructive of intraocular nematodes. Its victims may well exceed one million of the world's population. O. caecutiens (blinding worm), described as a separate species in Central America, is now believed by most nematologists to be identical with O. volvulus, and was carried to the Western Hemisphere via the slave trade. Onchocerciasis occurs endemically in two separate localities, central western Africa and Guatemala-Mexico.

Onchocerca volvulus exhibits four distinct stages: adult, egg, microfilaria (all human hosts), and larva (intermediate insect host). The adult worms can be described briefly as white threadworms. The adult males are 20 to 40 mm. in length and 0.2 mm. in diameter; the females are 335 to 500 mm. in length and 0.3 mm. in diameter. The female is ovoviviparous, the uterus being filled with both eggs and embryos. The advanced-stage embryo, the microfilaria, peculiar to this family of nematodes, escapes from the body of the female worms and gains entrance to the tissue spaces and possibly the lymphatics. The microfilariae demonstrate two forms (sexes?), a long type measuring 285 to 368 μ by 6.0 to 9.0 μ, while the short variety measures 150 to 287 μ by 5.0 to 7.0 μ. The microfilaria aggregate in the subcutaneous spaces, awaiting the appropriate insect host.

The microfilariae of Onchocerca are readily demonstrated by skin and conjunctival "snips." The biopsied tissues are placed in tepid physiologic saline and the organisms visualized under the microscope. In counterdistinction to the microfilariae of Wuchereria bancrofti, Wuchereria malayi, and Loa loa, these microfilariae are rarely, if ever, present in the blood stream; hence peripheral blood smears are of no value in establishing the diagnosis of onchocerciasis.

The intermediate host is the Simulium species, the black fly, which has the reputation of being a particularly vicious day-time feeder. With the human blood meal microfilariae enter the stomach of the insect and eventually reach the thoracic muscles, where several phases of development ensue. At the end of six days the mature filiform larvae migrate to the proboscis of the fly. During the insect's next blood meal, the larvae emerge from the mouth parts and penetrate the tissues lacerated by the Simulium bite. The larvae now conclude their life cycle in the human hosts.

The adult worms, one or more pairs, are typically located in fibrous subcutaneous nodules. In Guatemala and Mexico these nodules are situated generally over the temporal-parietal-occipital areas of the cranium. In Africa the lesions are confined for the most part to the trunk and extremities and show a predilection for bony pressure points, such as the iliac crests, rib margins, and juncture of long bones.

The formation of the nodules containing the adult Onchocerca evidences no correlation to the location of the instigating insect bite. The nodules appear in three to 10 months after the re-introduction of the larvae; full development of the nodules probably requires three to four years.

The lesions vary in diameter from six to 20 mm. and have been recorded up to five cm. The nodules feel rubbery, are obviously subcutaneous, and are not tender to palpation.

Grossly the nodules on section present a firm, grayish-white, fibrous capsule and a central cavity, yellowish in color, containing a milky material filled with an aggregation of adult worms and microfilariae. Histopathologic examination reveals the capsule to be composed of fibrous connective tissue with an occasional polymorphonuclear leukocyte, round cell, or eosinophil.

Onchocerciasis is not only more destructive than trachoma but, in addition to affecting the cornea, is capable of involving all the tissues of the globe. Pathologic lesions of the eye are induced by the invasion of the ocular and adnexal structures by the microfilariae, which often occur in massive numbers. Excellent dissertations on the subject of ocular onchocerciasis are available in the contributions of Ridley[11] and Clark.[12]

The microfilariae tend to swarm in the bulbar conjunctiva, and occasion surprisingly little tissue reaction. Only in a few instances is there a mild catarrhal conjunctivitis. Corneal lesions predominate and present a superficial punctate keratitis, with the punctiform infiltrations most frequently adjacent to Bowman's membrane, in the basal epithelial cells, and the anterior stroma. Ridley describes a nummular keratitis. The infiltrations are most prominent in the inferior aspect of the cornea.

A mild photophobia and slight lacrimation may or may not accompany the corneal involvement. Corneal vascularization and pannus formation are the exception despite extensive infiltration. Some authors feel that Descemet's membrane comprises a barrier which the microfilariae cannot penetrate and believe that the intraocular microfilariae gain entrance via the sclera.

By biomicroscopy, microfilariae of Onchocerca have been observed in massive numbers swimming vigorously in the aqueous. Scott,[13] in examining 342 Cameroon soldiers with the slitlamp, described aqueous microfilariae as a common finding, even in men appearing asymptomatic.

While viable the organisms induce little inflammatory response, dead microfilariae often occasion an iridocyclitis which is typically mild. The formation of synechias is relatively infrequent. The commonest iridic finding is a sector or generalized atrophy of the iris stromal pigment, which gives the iris a "spongy" appearance. Persistent iridocyclitis may be attended by complicated cataract, secondary glaucoma, and phthisis bulbi.

Often one sees a distinctive posterior polar retinopathy characterized by a combination of choroidal sclerosis, irregular deposition of retinal pigment without relation to blood vessels, and associated optic atrophy. Living microfilariae have been noted in the vitreous.

Lenticular involvement is rare but microfilariae have been visualized invading the anterior capsule of the lens. Clark and Silva[14] have reported the intraocular presence of adult Onchocerca volvulus. Silva observed a viable adult worm in the vitreous.

Very few globes containing Onchocerca have been examined microscopically. Primarily for religious reasons, the natives of both continents are opposed to enucleation.

For many years there has existed no satisfactory therapy for onchocerciasis. Surgical removal of the nodules containing the adult worms is of some benefit but does not constitute a cure. Injection of the nodules with various substances, in an attempt to destroy the worms, has not proven successful. It appears impossible to prevent contact with the Simulium hosts, due to the outdoor existence of the natives. The mountainous topography of the endemic areas and the breeding of the black fly only in rapidly flowing streams make impractical the use of DDT and similar chemicals as effective means of control.

Sarkies,[15] in his article on ocular onchocerciasis, considers the modern drugs now available for therapy. Hetrazan (diethyl carbamazine), a piperazine derivative, is efficacious against the microfilariae, but the simultaneous death of large numbers of intraocular microfilariae can occasion a severe endophthalmitis, with possible loss of the eye. Sarkies also utilized a more recent drug, Suraminin (Antrypol), and concluded that Suraminin is consistently effective against both microfilariae and adult parasites and feels that it is the drug of choice.

Loa loa. This filarial nematode, popularly known as the "African eyeworm," has been noted numerous times in medical literature. Loaiasis occurs endemically in central west Africa. Loa loa infections, usually in retired African missionaries and their families, occasionally are seen by the American ophthalmologist. Ward[16] reviewed two previous cases, and listed six more from North America (1906).

The morphology of the adult Loa loa resembles that of other filarial worms. The males measure 30 to 34 mm. in length and approximately 0.4 mm. in width; the females range from 50 to 70 mm. in length and about 0.5 mm. in width. The adults live in the subcutaneous tissues of man and migrate throughout the body. In subcutaneous situations this migration precipitates a transient tissue reaction, designated "calabar swelling." The worms, especially the immature forms, are prone to enter the orbit and pass subconjunctivally "across the eyeball," in which location, the worms are conspicuous, hence the term "eyeworm."

During their wanderings the mature Loa loa females discharge microfilariae into the subcutaneous and deeper cutaneous passages of the human host. These microfilariae gather in the peripheral vascular circulation. They manifest a definite periodicity and are found in the peripheral circulation in greater numbers during the daytime, hence the synonym, Microfilariae diura, in counterdistinction to the Microfilariae nocturna (Wuchereria bancrofti) which co-exist in some regions of Africa.

The Microfilariae loa undergo further development in the intermediate host, Chrysops, a species of mango fly, prone to feed on humans. The microfilariae leave the stomach of the insect, enter the muscular and connective tissues of its abdomen, and to a lesser extent the tissues of the thorax, and metamorphose into an infective larval stage in about seven days. These larvae then invade the mouth parts of the insect in anticipation of its next human victim. The larvae now invade the tissues of the human host and complete their development. The

adult Loa loa lives from four to 15 years within man.

The conjunctival invasion by this nematode induces a severe, boring type of pain which often interferes with sleep. In its migration the Loa loa has been known to enter the globe and, on at least three occasions, has been extracted from the anterior chamber (Ward[17]). Numerous personal accounts of the ocular migration of the Loa loa are recorded and make informative reading (Elliot[18] and Johnstone[19]).

Except for the distressing "calabar swellings" and the painful ocular migrations, loaiasis is usually regarded as a benign condition. However, Kennedy and Hewitt[20] describe two patients infected with Loa loa, who exhibited incapacitating malaise, marked personality changes, and frank psychotic episodes, which were ameliorated by surgical removal of the worms.

Microfilariae of Loa loa have not been incriminated in the etiology of ocular disease. They have not been reported in the aqueous.

Loaiasis is diagnosed by examining a peripheral blood smear, taken during the day for the specific Microfilariae loa. Often the superficial location of the adult worm affords a definite diagnosis.

Surgical excision of the adult Loa loa is advised whenever the worm appears superficially in the skin or under the conjunctiva from where it is readily removed. A topical anesthetic is instilled and the worm is quickly grasped with a forceps. A conjunctival incision, paralleling the worm, is then made and the Loa loa is grasped firmly by a second forceps and extracted gently. Infiltration anesthesia is not recommended for the worm is frequently lost when the tissues become distorted. Suraminin is reported as efficacious in destroying the adult worms in situ.

Wuchereria bancrofti. This nematode is the etiologic agent in Bancroft's filariasis which occurs indigenously throughout the world from about 41 degrees north to about 28 degrees south latitude in the Eastern Hemisphere and from about 30 degrees north to about 30 degrees south in the Western Hemisphere. The principal endemic regions are the southern coast of Asia from Arabia through India, Siam, the Malayan States to southern and central China, southern Japan, the Philippines, southwest Pacific, Colombia, Venezuela, the Guianas, northern Brazil, north Africa, and central Africa. Although the estimated world incidence (1947) of Wuchereria bancrofti and its relative, Wuchereria malayi, is 189 millions, encroachment on ocular tissues is very rare.

W. bancrofti, a typical filarial worm, creamy white in color, presents attenuated extremities. The male measures 40 mm. in length by 0.1 mm. in diameter. The female measures from 80 to 100 mm. in length by 0.24 to 0.3 mm. in cross-section. The adults live in lymphatic vessels and lymph nodes. Their presence induces a "filarial granulomatous reaction," which produces considerable lymphatic blockage. If the worms are numerous, the lymph stasis precipitates a clinical syndrome known as "elephantiasis." Generally the inguinal lymph nodes are implicated since W. bancrofti has a proclivity for this region; thus the genitalia and lower extremities are particularly prone to elephantiasis.

The Microfilariae bancrofti, on escaping from gravid females, either remain in the lymph or gain access to the bloodstream. In peripheral blood smears the microfilariae demonstrate the dimensions of 127 to 320 μ (length) by 6.5 to 10 μ (width). The microfilariae of W. bancrofti reveal a characteristic nocturnal periodicity (Microfilaria nocturna) which coincides with the feeding habits of its intermediate host, the mosquito. Dozens of species of mosquitos are capable of serving as temporary hosts. The microfilariae penetrate the mosquito stomach wall and migrate to the thoracic musculature. Further metamorphosis ensues and, in 10 to 40 days, depending upon species of mosquito and climatic temperature, the infective

larvae enter the head of the insect. The larvae are returned to the human host when the mosquito feeds. Approximately one year is necessary for the larva to develop into an adult worm within man, the only definitive host.

Elephantiasis of the eyelids has been recorded very rarely. Better appreciated is the occasional intraocular occurrence of Wuchereria bancrofti. Nayar[21] observed a filarial worm, 2.5-cm. long and 0.5-mm. wide, in a subretinal location. Subsequently the nematode invaded the vitreous and entered the anterior chamber where it remained free and alive for several days. The worm was removed via a small keratome incision but, unfortunately, was lost at surgery. In view of the dimensions and the residence of the patient in a district where filariasis was common, the author concluded that the worm was a Wuchereria bancrofti.

Wright[22] and Fernando[23] also encountered patients with viable adult filarial nematodes in the anterior chamber. At surgery the worms were evacuated and positively identified as Wuchereria bancrofti, male and female, respectively.

In the United States, Jones et al.,[24] in Portland, Oregon, described a woman with a living nematode in the anterior chamber. It conformed to the gross morphology of Wuchereria bancrofti. The patient had spent her entire life on the Pacific coast. The specimen was removed from the eye but it, too, was lost for identification purposes.

Microfilariae bancrofti have not been reported intraocularly and the possibility of their ocular occurrence is considered unlikely.

Wuchereria bancrofti filariasis is diagnosed by the demonstration of the specific microfilaria in a nocturnal peripheral blood smear. Hetrazan is regarded as the drug of choice for treatment but, again, it should be given cautiously, in several short courses, to avoid inducing a hypersensitivity reaction to toxins liberated by the dead and dying worms.

Wuchereria malayi. The microfilariae (1927) and the adult forms (1940) have been shown to constitute a distinct species. Wuchereria malayi is extensively distributed throughout India, Indochina, coastal China, Indonesia, Borneo, and New Guinea. In some areas it is the only human filariasis; in others it co-exists with W. bancrofti. The Microfilaria malayi exhibits a partial nocturnal periodicity. In contrast to Bancroft's filariasis, Malayan filariasis manifests a predilection for the lymphatics of the upper extremities.

Ocular involvement has not been reported with W. malayi but, probably, intraocular infection with the adult worm has occurred. Wright, in reviewing Nayar's case of anterior chamber Wuchereria, noted that Malayan filariasis was endemic in the patient's home district and rightfully questioned Nayar's conclusion that the worm was Wuchereria bancrofti. The worm was lost and its species is a matter of conjecture.

The diagnosis and therapy of Malayan filariasis is identical to those for Bancroft's filariasis.

Dirofilaria conjunctivae (Addario, 1885). This classification of filarial nematode is ill-defined. D. conjunctivae includes the sporadic reports of unidentified filarial worms removed from ocular tissues, usually the conjunctiva. Of necessity, D. conjunctivae must embrace several species. The majority of the cases of Dirofilaria conjunctivae have originated from the Mediterranean basin. Parodi and Bonavia, quoted by Faust, described removing a filarial species "from the eye" of a woman living in Argentina. These reports are all in the foreign literature; no cases were encountered in English literature.

The Department of Tropical Medicine and Public Health, Tulane University School of Medicine, has received from Florida several specimens of granulomas excised from human eyelids. On sectioning, the nodules contained filarial nematodes, tentatively identified as Dirofilaria immitis, the dog

heartworm, which is extremely common in this area. The worm specimens were immature; they are probably incapable of reaching maturity in human tissues. No microfilariae were discovered.

The life history of D. conjunctivae is not known, although the mosquito is believed to be the intermediate arthropod host, as it also is with D. immitis. Intraocular encroachment has not been demonstrated.

ASCARIDIDAE

Ascaris lumbricoides. This nematode is the giant intestinal roundworm, familiar to all general practitioners and pediatricians.

A. lumbricoides is widely distributed throughout the world except in frigid climes. Children are especially prone to infection. The adult nematodes are elongated and cylindric. The male has a length of 15 to 30 cm. and a diameter of 2.0 to 4.0 mm.; whereas, the female has a length 20 to 35 cm., occasionally 40 to 49 cm., and a diameter of 3.0 to 6.0 mm. The maturing and mature worms live in the lumen of the small intestine and subsist on the semidigested food mass.

The ova, discharged with the feces, are broadly ovoidal, exhibit a thick, transparent shell, and measure approximately 42 by 60 μ. In the soil, the eggs display further development and remain viable and infective for years, depending on local environmental conditions.

The ova must be swallowed for ascariasis to occur. No convincing evidence exists that infection may be precipitated by cutaneous contact. Unlike the filarial nematode, there is no intermediate host. The eggs hatch in the duodenum but the ascaris larvae must first complete an extra-intestinal migration before returning to the bowel to conclude maturation.

The larvae penetrate into the mesenteric veins or lymphatics and are carried to the right heart via the inferior vena cava or thoracic duct; eventually they reach the lungs. In the pulmonary tissues the larvae grow and break out of the capillaries into the alveoli (verminous pneumonitis). Next they migrate up the bronchi and trachea to the epiglottis and are swallowed, thus achieving their natural habitat.

During the migration some larvae occasionally enter aberrant foci, such as peripheral lymph nodes, thyroid, brain, and so forth. This somatic migration, which is accentuated in the abnormal host, will be considered again in the discussion of the Toxocara species. The larvae, measuring 0.2 to 0.3 mm. in length by 14 μ width, require approximately five days from ingestion of the eggs to arrive in the small intestine. The Ascaris lumbricoides attain maturity in two to two and a half months. Man is his own sole source of his ascaris infections.

The number of adult ascaris present in the bowel varies widely from a single specimen to hundreds. It is not unusual to find several hundred in children under five years of age on the pediatric service of Charity Hospital in New Orleans. Although generally considered a relatively benign condition, ascariasis can be responsible for numerous complications and deaths. Intestinal obstruction, perforation of the bowel, appendicitis, blockage of bile ducts, fatal pneumonitis, laryngeal obstruction, and esophageal perforation have all been reported.

In very rare instances ascaris larvae can invade ocular tissues. Calhoun[25] reported an intraocular ascaris larva in an eight-year-old Georgia boy. During its intraocular migration, the worm caused dislocation of the lens, acute iridocyclitis, and secondary glaucoma. Beautyman and Woolf[26] recorded the incidental finding of an encapsulated larva of A. lumbricoides in the thalamus in sections of the brain of a six-year-old girl who succumbed to poliomyelitis. Ward quotes Hoffner's case of a one-year-old child sick with pertussis, who presented an ascaris larva lying in the conjunctival sac and protruding from the inferior lacrimal punctum. Apparently during a paroxysm of coughing the worm had entered the nasopharynx and

subsequently the nasolacrimal passages.

Ascaris conjunctivitis is a recognized entity; it occurs in butchers, laboratory workers, and other individuals who inadvertently splash portions of the ascarids or their metabolic products into their eyes while cutting up meat or handling the various species, particularly A. megalocephala (horse), a common laboratory specimen. An acute allergic conjunctivitis ensues. Jeffery[27] submits evidence that A. lumbricoides is responsible for cases of phlyctenular keratoconjunctivitis in India.

The diagnosis of Ascaris lumbricoides is determined by the examination of fecal specimens for the ascaris eggs. Sometimes the adult nematode is vomited or passed per rectum and is readily identified.

Piperazine (Antepar) has superseded Hexylresorcinol as the best drug in the treatment of intestinal ascariasis.[41] No known anthelminitic is effective during the migrating phase.

Toxocara canis and Toxocara cati are the ascarids which will be discussed under Part II of this paper.

ANCYLOSTOMITIDAE

Necator americanus. This species is the common hookworm of the southeastern United States. Native to tropical and southern Africa, it was introduced to the new world by African slaves. The adult worm is grayish-yellow in color, with an occasional reddish cast. The males measure approximately 8.0 mm. in length by 0.3 mm. in breadth. The female measures approximately 10 mm. in length by 0.4 mm. in breadth. Necator americanus adults live in the small intestine of man.

The life cycle of this hookworm is complex but implicates no intermediate host. The eggs are disseminated in the feces of infected individuals. Moist, warm, sandy soil constitutes an ideal culture medium for the hatching, feeding, and metamorphosis into infective filiform larvae, which measure 0.5 to 0.6 mm. in length.

An egg develops to the infective larval stage in about nine days. Upon contact with exposed surfaces of feet and ankles, the larvae readily penetrate the skin and ultimately reach the pulmonary circulation. This cutaneous invasion induces "hookworm dermatitis," also known as "ground itch." In the lungs the migrating larvae bore out of the capillaries, enter the alveoli and bronchioles, ascend the epiglottis, and are swallowed.

On reaching the small bowel, the adolescent worms attach themselves to the intestinal wall and, by suction with the mouth parts and elaboration of lytic enzymes, erode the mucosa and stroma of intestinal villi. The worms nourish themselves on the resultant hemorrhagic extravasations and frequently change locations when the "old" site proves unprofitable.

The severity of the consequent anemia is roughly correlated with the number of hookworms harbored. Children with heavy infections, in addition to hookworm anemia, may show hypoproteinemia, chronic malnutrition, and retardation of physical, mental, and sexual development.

Calhoun[28] first called attention to the eye complications in hookworm disease. Exudative and hemorrhagic retinopathy occur as an ocular manifestation of severe hookworm infection. Calhoun presented reports of four patients with complicated cataracts. He concludes that toxins liberated by N. americanus and, to an extent, the anemia were responsible for the pathologic ocular alteration. Intraocular invasion was not considered.

The nematode larvae discovered in Wilder's series of 24 eyes were identified as "third-stage hookworm larvae. . . . No information as to species has been obtained. However, Ancylostoma sp., Necator sp., and Uncinaria sp. are possibilities."

Hookworm infection is diagnosed by fecal examination for the eggs. Tetrachloroethylene is still the most effective drug against hookworm disease.

Ancylostoma duodenale. This species of hookworm is morphologically similar to N. americanus and exhibits the same life cycle. A. duodenale is the hookworm of temperate regions and is found throughout southern Europe, north Africa, northern India, and central parts of China. It is infrequent in the United States of America. It is capable of inducing the same pathologic lesions and syndromes. Some nematologists state that A. duodenale occasions a more severe anemia than N. americanus. Its ocular manifestations are the same as those of N. americanus.

Diagnosis and therapy are identical.

GNATHOSTOMATIDAE

Gnathostoma spinigerum. This nematode is an infrequent human pathogen. Most cases of gnathostomiasis have been reported from the Malayan peninsula, especially Thailand (Siam), although sporadic cases have occurred in India, Japan, and China. Domestic cats, tigers, leopards, and sometimes the dog serve as reservoir hosts.

Gnathostoma spinigerum is a robust nematode, reddish in color, slightly transparent, and presents a globular cephalic swelling. The eggs, evacuated in the feces of a cat, the usual reservoir, embryonate and hatch in fresh water in about one week. The resultant first stage larvae measure about 250 μ by 15 μ and survive free in the water for a few days, anticipating ingestion by species of Cyclops (water fleas). The larvae next undergo further transformation in the arthropod's hemic cavity. A second intermediate host, a fresh-water fish, frog, or snake, is necessary. The larvae subsequently encapsulate in the muscles, liver, and other tissues of these hosts. The cat develops the infection when the involved fish is eaten.

The lesions observed in the reservoir hosts usually consist of "stomach nodules" which contain one or more mature worms, lying free in an abscess pocket in the tumefaction located on the internal aspect of the stomach wall (Gnathostomiasis interna). However, in the human host, cutaneous or subcutaneous nodules or an eruption, suggestive of migrating hookworm larvae, occur (Gnathostomiasis externa). The exact mode of transmission to the human is not known, although accidental contact or ingestion of the infected Cyclops seems likely.

Sen and Ghose[29] introduced to ophthalmic literature the first and probably only case of ophthalmic gnathostomiasis. A 26-year-old Brahmin woman was referred for evalution of an orbital cellulitis associated with vitreal and retinal hemorrhages in the involved eye. A nodular type of iritis was noted but the nodules appeared and regressed rapidly. Finally a worm was seen in the anterior chamber. It was four-mm. long and its morphology differed from that of Wuchereria bancrofti or a maggot. The specimen was successfully removed and identified as an immature Gnathostoma spinigerum.

The only advised treatment for gnathostomiasis is the excision of the worm and adjacent altered tissues.

TRICHINELLIDAE

Trichinella spiralis. This worm is the causative agent of trichiniasis or trichinosis. Three-fourths of the estimated world incidence of trichinosis has been assigned to North America.

The adult worms are minute and exist attached to or buried in the mucosa of the duodenum and jejunum. The males have a linear measurement of about 1.5 mm. and a transverse measurement of 40 to 50 μ. The females measure 3.0 to 4.0 mm. in length and about 60 μ in diameter.

The viviparous young are deposited in the lymphatics and tributaries of the mesenteric veins. Each female, regarded as having a life span of four to eight weeks in the human host, may release 1,500 larvae, which measure about 100 μ and 6.0 μ (linear and transverse dimensions) and, because of their minute size, are capable of passing through both hepatic and pulmonary filters during their migration.

The larvae, while in the arterial circula-

tion, migrate to all parts of the body; however, they are able to develop only in striated muscle. The first larvae reach their destination approximately seven days after infection. In skeletal muscle, the larvae desert the capillaries, become coiled up, and grow to about one mm. in length. Their presence provokes a tissue reaction which terminates in the encapsulation of the larvae.

The larvae of T. spiralis manifest a predilection for the diaphragm, biceps, pectoralis delatoids, and the muscles of the larynx, tongue, abdomen, and intercostal spaces. The extraocular muscles in infected hogs are "particularly heavily infected" (Ward), and undoubtedly some of the orbital edema and especially the pain accompanying ocular movements in humans are occasioned by larvae encysting in the extraocular muscles.

Central nervous system involvement in trichinosis was described first by Frothingham.[30] Hassin and Diamond[31] reported the second case and discussed the brain findings in a patient dying with trichinosis encephalitis. Large numbers of Trichinella spiralis larvae were abundant, particularly in the occipital cortex, parenchyma of the brain, and in the cavities of the lateral and fourth ventricles.

Salan and Schwartz[32] observed paresis of the left lateral rectus muscle, right facial palsy, and congestion of the optic discs in a patient with trichinosis encephalitis. Most and Abeles[33] reviewed the subject of involvement of the nervous system with trichiniasis and reported two more cases. These authors reiterated that invasion of the nervous system in trichinosis is not widely appreciated.

Pronounced eosinophilia associated with orbital edema are almost diagnositic of human trichinosis. Quite often the ophthalmologist is the first to become aware of an impending epidemic. Edwards[34] reports a recent outbreak of trichiniasis in Liverpool. It is his conviction that the eye signs represent an acute allergic response which appears in a few days after the ingestion of "measly pork," and precede the general dissemination of the trichinella larvae. The author feels that the extraocular muscles are implicated in the late stages of the infection, as the orbital edema is subsiding.

In addition to the orbital edema and pain with ocular movements, numerous other findings, such as conjunctivitis, photophobia, altered pupillary light reflexes, disturbances of accommodation, retinal hemorrhages, papillitis, diplopia, and visual field defects, have been reported. These could be directly attributed to an intraocular encroachment, or indirectly attributed to the central nervous system involvement. No reports of intraocular trichinella larvae were encountered, yet some of the migrating larvae probably do circulate through the intraocular vascular system prior to entering muscle fibers.

Diagnosis is afforded by the history of eating infected, uncooked pork products and the classic clinical findings. There is no known effective treatment against the migrating larvae. Supportive therapy is indicated. Experimental studies indicate that Piperazine may remove the adult worms from their intestinal abode.

Dracunculidae

Dracuncula medinensis. The "fiery serpent" of Biblical fame is also designated as the "Guinea worm" and "serpent worm." Its endemic areas include the Nile valley, central equatorial Africa, the west coast of Africa, the Sinai peninsula, and India.

The adult worms live in the viscera and subcutaneous tissues of human hosts. The gravid females usually measure about one meter in length and about 0.12 mm. in width. The males, rarely found in human infections, measure 2.0 to 4.0 cm. in length and 0.4 mm. in diameter.

The sexually mature female migrates to a subcutaneous location in a portion of the body periodically bathed in water. The feet and ankles most often are the sites of the lesions. The cephalic portion of the gravid female induces a vesiculation of the over-

lying dermis. This "blister" ruptures when it comes in contact with fresh water, and motile larvae, about 600 μ in length and 20 μ in width, are discharged.

These larvae are ingested by an appropriate species of Cyclops (water flea), and the larvae enter the coelemic cavity of the arthropod and undergo metamorphosis. If the Cyclops should inadvertently be ingested by man, the D. medinensis larvae escapes from the insect host, penetrates the stomach or intestinal wall, migrates through the tissues, and lodges in the viscera or connective tissues of the human host. At least eight months are required before the female worm matures.

Ward called attention to the fact that the Loa loa was confused with D. medinensis and was so reported in early medical writings. Ward felt that ocular involvement was unlikely in Dracuncula medinensis infection. Ridley contends that dracontiasis can encroach upon orbital and ocular tissues and refers to a case which showed the calcified remains of a large worm, presumably a Guinea worm, demonstrated per roentgenography to be lying in the orbit. No intraocular dracontiasis has been substantiated. The Filaria medinensis in the anterior chamber, reported by Barkan,[35] is believed by authorities to represent an unknown Australian species of filaria. The patient resided in Adelaide, Australia, prior to his arrival in San Francisco.

Thelaziidae

Thelazia callipaeda and Thelazia californiensis. T. callipaeda exists as an occasional infection of the conjunctival sac of dogs in Burma and most of China. Price[36] recorded the discovery of a distinct North American species, while indentifying nematodes obtained from the conjunctivas of Californian dogs. He described its morphology minutely and named this "new" species of nematode, Thelazia californiensis.

The adult worms range in size from 4.5 to 13 mm. by 0.25 to 0.75 mm. for males, and 6.0 to 17 mm. by 0.3 to 0.85 mm. for females. The life cycle is not known. The worms, usually immature forms, live in the conjunctival sac of the host and usually produce little conjunctival reaction. However, their presence in the conjunctiva can be annoying and may precipitate episodes of intense local pain.

T. californiensis has been recorded erroneously in the literature as an intraocular nematode. Review of the cases of human ocular thelaziasis in the world literature reveals only their typical conjunctival location. Howard,[37] writing from Peking, China, reviewed the previous Chinese cases, reported independently by Stuckey and Trumble. He presented his own case of "circumocular filariasis" in a 52-year-old Canadian missionary and proposed the term" thelaziasis." Two human infections in California with T. californiensis have been reported by Koford and Williams[38] and Hosford et al.[39]

Extraction of the thelazia from the conjunctival sac effects a cure.

Acuariidae

Cheilospirura species. Nematodes of the genus Cheilospirura occur as natural parasites between the tunics of the gizzard of birds in various parts of the world. Grasshoppers are believed to serve as intermediate arthropod hosts, otherwise little is known regarding the life history of the worm.

Only one infection with Cheilospirura species is recorded, that of Africa and Garcia.[40] These authors identified as Cheilospirura sp. fragments of a nematode removed from a conjunctival nodule of a 70-year-old Filipino farmer.

Strongyloididae

Strongyloides stercoralis. This roundworm, known as the "human threadworm," is the responsible agent in strongyloidiasis or strongyloidosis. Strongyloidosis is found frequently accompanying human hookworm infections. Most reports from the United States originate from Louisiana but cases

are recorded from Missouri, Tennessee, Ohio, Pennsylvania, and New York. S. stercoralis is prevalent in southern Asia, Africa, and tropical America but is relatively uncommon in China and French Indochina.

The nematodes are colorless, nearly transparent filiform objects. The adult parasitic male measures about 0.7 mm. in length and 40 to 50 μ in diameter; the adult female measures about 1.0 mm. in length and 50 to 75 μ in diameter. The species demonstrates an ability to exist both as free-living forms and as parasites of man.

The life cycle of S. stercoralis is similar to the life cycle of the ancylostomes, Ancylostoma and Necator species. The larvae penetrate the skin of the foot or ankle and manifest a somatic migration which includes the pulmonary parenchyma, lower respiratory passages, epiglottis, and finally the upper portion of the small intestine where maturation is completed. Chance cerebral invasion by the larvae of S. stercoralis probably does occur from time to time. Utilizing human strains of Strongyloides stercoralis, Faust described hemorrhages in the meninges and perivascular tissues of the brain in experimental infections in dogs.

Intraocular strongyloidiasis has not been reported but S. stercoralis has the potentiality of occasioning a nematode endophthalmitis and should be considered in any differential diagnosis.

Trichocephalidae

Trichocephalus trichiuris. This nematode, popularly designated the "human whipworm," is cosmopolitan in distribution. The male is about 40 mm. long, and the female a few millimeters longer. T. trichiuris may be found in the mucosa of the caecum, appendix, and colon in large numbers, particularly in young children. Its life cycle in the human is confined to the gastrointestinal tract, hence it may be disregarded by ophthalmologists. Rarely do secondary anemia or gastrointestinal symptoms appear, findings which would occur only in heavy infections.

Oxyuridae

Enterobius vermicularis. This worm, the "pinworm" or "seatworm," is well known to the medical profession and accounts for most cases of peri-anal pruritis in children. Enterobiasis is found throughout the world.

E. vermicularis is a whitish threadlike worm. The males measure 2.0 to 5.0 mm. in length by 0.1 to 0.2 mm. in diameter. The females measure 8.0 to 13 mm. in length by 0.3 to 0.5 mm. in diameter. The motile adult is frequently observed about the anal structures, as the female lays her eggs in this area.

Enterobius vermicularis requires neither an intermediate host nor any considerable period of incubation outside the body. Autoinoculation with the eggs is common, especially in individuals with unhygienic habits.

E. vermicularis, similar to T. trichiuris, has a life cycle involving only the gastrointestinal tract and, hence, is not a causative agent in nematode endophthalmitis.

Part II: Toxocara species as human pathogens

Toxocara canis

This nematode is the cosmopolitan intestinal parasite of dogs. The worm resembles other members of the family Ascarididae in appearance. Taylor[42] reviewed the morphology of Toxocara canis and its related species, Toxocara cati. The males are 4.0 to 6.0 cm. long and about 2.0 mm. in diameter; the females are 6.5 to 10 cm. long and about 3.0 mm. in diameter. The adult T. canis presents prominent cervical alae (wings), which extend some distance from the anterior end along the lateral margins. In cross-section, these alae demonstrate a deeply cleft, three-pronged core which supports the wing structure. Occasionally the adults may be seen in the vomitus and stools of dogs.

In its normal host, the dog, T. canis exhibits a life cycle paralleling that of the familiar human ascarid, Ascaris lumbri-

coides, described earlier in this article. The eggs of T. canis are ovoid in contour, pitted superficially, and measure 75 to 85 μ in lesser and greater diameters. The ova are quite resistant to desiccation and other unfavorable environmental conditions. In the dog intestine, the ova hatch and the larvae exhibit a typical tracheal migration and maturate in the small bowel. During the migration the larvae measure about 400 μ in length and 20 μ in diameter.

The incidence of T. canis in dogs has been ascertained in sporadic and scattered surveys. The recent demonstration of T. canis larvae within abnormal human hosts has precipitated renewed interest in the parasite. Hinman and Baker[43] autopsied 1,315 dogs in New Orleans and reported an over-all incidence of T. canis of 1.9 percent, a very low percentage in comparison to later surveys. These authors were impressed by the resistance shown by adult dogs toward the parasite. Compiling puppies separately, the incidence of T. canis was 4.7 percent. Several instances of death in young puppies were attributed to T. canis infection. Hinman and Baker compared the age-resistance of other hosts to their specific ascarids, Ascaris lumbricoides in humans and Ascaridia lunecata in chickens,[44] and noted similarities.

Ehrenford,[45] utilizing fecal examination of dogs as advocated by Goss and Rebrassier,[46] discovered Toxocara canis in 25 percent of dogs in the midwest. Ehrenford,[47] further stimulated by recent public health interest in T. canis, examined the feces of 1,465 midwestern dogs and reported an over-all incidence of 21 percent. Analysis of the data obtained again revealed the highest incidence in puppies Adult females were more resistant than males. Males alone manifested a seasonal trend (highest in winter). The breed of dog was of no significance.

In Boston veterinarians recorded a 20-percent incidence of T. canis in local dog feces, and also noted the highest incidence in very young dogs.[48] Eighty-one puppies examined by Yutac[49] in the Philippines revealed a 76.5 percent incidence of T. canis. This author attributed the high infection in puppies to the penetration of the placental barrier in gestating female dogs, and estimated the prepatent period in prenatally infected puppies as about 25 days.

In the past few years Toxocara canis has been incriminated in the etiology of the eosinophilia-hepatomegaly syndrome of infants and small children. The child, often a "dirt-eater," develops the infection by swallowing fertile T. canis eggs.

Beaver et al.[50] introduced the concept that prolonged migration of nematode larvae within human tissues was responsible for some instances of unexplained eosinophilia. These authors called attention to the similarity to "cutaneous larva migrans," (creeping eruption), the dermatitis occasioned by the invasion and aimless wandering of nonhuman hookworm larvae, and proposed the term "visceral larva migrans." The term received immediate acceptance. Many articles concerning visceral larva migrans have appeared recently in pediatric,[48,51] pathology,[52] and veterinarian[53] medical journals.

Dent et al.[52] reported the autopsy findings of a 19-month-old white boy with visceral larva migrans. The child had succumbed to an episode of homologous serum hepatitis, approximately seven weeks after a liver biopsy, obtained at laparotomy, revealed larvae of T. canis. The gross and microscopic pathologic lesions are described. Unfortunately, the eyeballs were not examined microscopically.[54] Press preparations and pepsin digestion of fresh tissue taken at necropsy afforded a quantitative estimate of the number of larvae present. From the liver, 60 larvae per gm. were recovered per pepsin digestion. Brain tissue produced three to five larvae per gm. All the larvae were motile and identified as Toxocara canis. Brill et al.[55] and Milburn and Ernst[56] reported Toxocara species in lung tissue (autopsy) and liver tissue (biopsy specimen at laparotomy), respectively.

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The morphology of the infective second stage Toxocara larvae is well described by Nichols.[57, 58] The larvae range from 360 to 440 μ and exhibit a maximum diameter of 18 to 22 μ.

"Under low magnification each larva can be divided roughly into two portions: a clear esophageal region occupying less than one third of the total length and a more dense intestinal region packed with refractile globules and terminating about 60 μ anterior to the tip of the tail. The larvae are elongated, cylindric organisms with the body having almost parallel lateral margins, as seen in the optical plane. The anterior quarter of the body tapers equally to a three-lipped, subterminal, dorsally inclined mouth. Anterior to the mouth a sharp spinelike cuticular thickening is found on the ventral margin of the buccal capsule. This latter oral structure is quite characteristic of the early second stage Toxocara larvae and facilitates their identification in pepsin digest and in press preparations. The posterior end is tapered more abruptly, commencing anterior to the termination of the intestine and continuing to a slender attenuated tail.

"In stained sections T. canis larvae can be identified accurately by the use of several morphologic characters not shared with other nematodes likely to be encountered in human tissue." [52]

Recent investigations of Toxocara canis, including experimental research, have proved illuminating. Sprent[59] reviewed all phases of the life cycle of nematodes of the family Ascarididae. He particularly discussed the "somatic migration" of the larvae in abnormal hosts and contemplated that this phenomenon is the more primitive characteristic; while "tracheal migration" represents a later adaptation to noncarnivorous hosts. The author concluded by summarizing the evidence for the utilization of intermediate hosts by members of the family Ascarididae.

Sprent[60] evaluated the pathologic significance of invasion of the central nervous system by nematodes and discussed the mechanisms involved. In a separate article, Sprent[61] specifically considered the invasion of the nervous system in ascariasis. Experimental ascariasis was induced in mice, by feeding fertile eggs of several ascarids, including T. canis. Separate infections were introduced by utilizing calculated doses of ova from a single species of Ascarididae.

In evaluating the results the author noted a striking difference among the various species. Most outstanding was that T. canis larvae showed a marked predilection for the brain tissues of the mouse. The author concluded that the larvae of T. canis reached the brain of the mouse in relatively large numbers and remained in the brain tissues for several months. Gross and miscroscopic findings in these mice were reviewed. The larvae do not grow during their sojourn in the tissues of the abnormal host. This statement has been confirmed by others.

Sprent fed 3,000 to 5,000 infective eggs of T. canis to 12 mature dogs and subsequently demonstrated larvae in the brains of two of the animals.

By administering a calculated dose of T. canis larvae to two mentally defective infants, Smith and Beaver[62] proved conclusively that the larvae of Toxocara canis can hatch in the human intestine with subsequent invasion of viscera and the production of chronic eosinophilia. These authors also fed T. canis eggs to mice and noted the large proportion of larvae in the brain of the mouse.

Nichols[63, 64] has studied the morphologic tissue characteristics of other nematodes concerned in the etiology of visceral larvae migrans.

The dimensions of the Ascaris larva reported by Beautyman and Woolf[26] are more consistent with the morphology of Toxocara canis than Ascaris lumbricoides.[57, 61] In retrospect the case history is interesting. . . . "The patient did not mix much with other children but was always playing with cats and dogs and was in the habit of sucking her thumb."

A study of the available material from Wilder's 24 cases of nematode endophthalmitis[3] revealed the structure of the larvae to be identical to that of Toxocara,[57] and the granulomatous tissue reaction to be similar to the lesions described by Dent et al. in the tissues of the autopsied patient.[52] Reclassification of the larvae discovered by Wilder as second stage Toxocara canis would afford an explanation as to why most of the patients in Wilder's series did not reside in the "hookworm belt" of the southeastern United States. Toxocara infections have been reported from 12 states, Puerto Rico, and England.

A satisfactory serodiagnostic test for Toxocara has yet to be evolved. Heiner[48] reported that his antigens were satisfactory in precipitation reactions in gel but were unreliable intradermally. Jung[65] is conducting similar investigations. Fellers[66] prepared an antigen from fresh adult Toxocara canis and Ascaris lumbricoides specimens and introduced his antigenic extract to standard serial dilutions of blood sera, with varying results.

At the present time there is no medication effective against the migrating larvae of Toxocara canis. Supportive measures and prevention of further infection are indicated.

Toxocara cati. This is the common ascarid found in the intestine of the cat. Although slightly smaller, the dimensions given for T. canis suffice for T. cati. The adult worms display characteristic heart-shaped lateral alae, which are relatively broad. In morphology and life cycle T. cati resemble T. canis.

Hitchcock[67] reported an incidence of 67 percent of T. cati in 147 Michigan kittens. T. canis was found in one percent of these 147 kittens. Baugh and Bliznick,[68] in a series of 126 cats from upper rural New York State, discovered T. cati in 63 percent. Searles and Stoll[69] were unable to superimpose T. cati infections in mature cats.

Toxocara cati, unlike Toxocara canis, has been reported unequivocally as an adult intestine parasite in the human bowel. Swartzwelder[70] reviewed the literature and described two T. cati specimens regurgitated by a seven-year-old Negro boy.

Although the Toxocara canis species is responsible for most instances of invasion of human tissues, Toxocara cati still must be considered in the differential diagnosis of visceral larva migrans and nematode endophthalmitis.

Summary

The subject of intraocular nematodiasis has been reviewed

The evidence for the incrimination of Toxocara canis larvae as a causative agent in visceral larva migrans and nematode endophthalmitis has been presented.

Since the distribution of Toxocara canis, the dog ascarid, is universal and proximity of young children to dogs is frequent, it may be assumed that, in the future, ophthalmologists, cognizant of the relationship, will contribute additional cases of intraocular Toxocara canis larvae.

It is hoped that the information presented in this article will prove of value to the ophthalmologist confronted with one of the most perplexing and disturbing problems encountered in ophthalmic practice, that of a child with a suspicious intraocular mass.

Contact with a puppy and/or a history of geophagia (dirt-eating) are important factors to be considered in the differential diagnosis of retinoblastoma and pseudoglioma.

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VITREOUS HEMORRHAGE*

Associated with sickle-cell trait and sickle-cell hemoglobin-C disease

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Recently, several excellent reports have described the clinical features associated with the various hemoglobin-types.[1-4] However, surprisingly little mention has been made of the occurrence of spontaneous hemorrhage into the vitreous in these conditions. Since electrophoresis of hemoglobin has made possible the accurate differentiation of the several variants of sickle-cell disease, only one case of spontaneous vitreous hemorrhage associated with sickle-cell trait has been reported,[5] to our knowledge, and only 10 cases in association with sickle-cell hemoglobin-C disease.[2,5,6] There have been a few general reports[7-11] of vitreous hemorrhage occurring in patients whose red cells sickled but these cases were not proven by electrophoresis, and the clinical data provided were often insufficient to warrant a definite conclusion as to which of the variants of sickle-cell disease was present.

Inasmuch as hemorrhagic phenomena, such as hematuria, have been described in several forms of sickle-cell disease and are presumably related to the sickling process and resultant thromboses, it is rather surprising that, according to recent reports,[5,6] no case of vitreous hemorrhage has been found in association with sickle-cell anemia which represents the severest form of the disorder. Furthermore, only one case has apparently been associated with sickle-cell trait which is the mildest or essentially asymptomatic carrier state.[5] Even in this case, an unrelated chorioretinitis could not be excluded. Our case material to be presented suggests that the occurrence of spontaneous vitreous hemorrhages must be considered in patients with sickle-cell trait.

Sickle-cell trait occurs in about nine percent of American Negroes and is characterized by the presence of both normal hemoglobin (A) and sickle hemoglobin (S).[1] These patients do not have anemia and are asymptomatic except for rare complications such as painless hematuria[1] and occasional occurrence of splenic infarction in association with flying in unpressurized airplanes at moderate to high altitudes.[12] Sickle-cell hemoglobin-C disease is the result of the combination of two abnormal hemoglobins, S and C, and is manifested by a chronic mild to moderate hemolytic anemia, slight reticulocytosis, inconstant icterus, many target cells in the peripheral blood smear, and, often, hepatosplenomegaly. Painless hematuria and splenic infarction in association with flying have also been reported in this disease.[1] In either case the red blood cells can be made to sickle under appropriate conditions; hence the sickle-cell preparation is positive. An excellent review of the hemoglobinopathies has been published recently by Chernoff.[1]

It is our purpose to present four cases of vitreous hemorrhage in association with sickle-cell trait and to add three cases of vitreous hemorrhage occuring in patients with sickle-cell hemoglobin-C disease observed during the past three years. All these cases were electrophoretically proven to have characteristic hemoglobin patterns and, in two of the cases, special coagulation studies are reported.

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Case reports

Case 1

W. L., a 39-year-old Negro, was seen at the City of Detroit Receiving Hospital after suddenly developing blurring of vision in his left eye while walking down the street on the night of admission in May, 1956. He noticed "cords" drifting in front of his left eye at this time and came to the hospital. This episode was entirely painless and unrelated to trauma.

His past history revealed that he had been chided as a schoolboy because of a "crossed eye." He did not have an examination of his eyes until 1942 when he was rejected from the Army because of poor visual acuity in his right eye. Otherwise, he had been in excellent health. He denied any bleeding tendency either personal or familial, jaundice, crises, or other evidence of sickle-cell disease.

His physical examination was entirely within normal limits except that his vision was 20/200 in his right eye and 20/40 in his left eye. Examination of the left eye showed a markedly reddened disc with a discrete inferior margin which was clouded by a fresh hemorrhage one disc diameter in size and extending into the vitreous. The latter showed clouding over the hemorrhage. The periphery was normal. Later, it was noted that the hemorrhage had extended with profuse bleeding over the upper half of the disc and along the superior temporal vein. Small patches of blood were scattered around the disc and in the temporal quadrant.

The right eye revealed a nebula of the cornea in the central pupillary region and a pale gray disc. The vessels were normal. No hemorrhage, exudates, or microaneurysms were seen. The posterior pole was clear but the foveal reflex was not seen clearly.

Laboratory examinations revealed a hemoglobin of 13.7 gm. per 100 ml., a red blood cell count of 5.6 million per cu. mm., and a white blood cell count of 5,000 per cu. mm. with a normal differential. The sickle preparation was positive. The platelet count was 445,000 per cu. mm., bleeding time two min. (Duke), clotting time 12.5 min. (Lee-White), and prothrombin time 15.5 sec. with a control of 13.3 sec. The prothrombin consumption test was normal. The Rumpel Leede phenomenon was negative, as were the routine urinalysis and serologic test for syphilis. Other studies included a blood sugar of 88 mg. per 100 ml. and a blood urea nitrogen of 17 mg. per 100 ml. Hemoglobin electrophoresis revealed a pattern (fig. 1) characteristic of sickle-cell trait (hemoglobin A and S). The tuberculin skin test was negative in 1:1,000 dilution.

The patient was treated with bedrest, vitamin K, ascorbic acid, multivitamins, rutin, and microwave diathermy. Gradual improvement followed and he was discharged after 11 days of hospitalization. Approximately nine months later he returned for an examination. His visual acuity was 20/200 with correction and with pinhole vision in the right eye and 20/20—4 in the left eye. A 16-diopter exotropia of the right eye was present for near and far vision. His near-point of convergence was 120 mm., right eye. The remainder of the external examination was within normal limits.

Funduscopic examination was particularly difficult because of a hazy media; however, the left eye was normal except for an area of whitish, flocculent, exudate extending from the 4- to 8-o'clock positions inferiorly and located within the vitreous and in the preretinal area. The collection of exudate seemed limited in its movement and confined inferiorly. There was no evidence of neovascularization, retinitis proliferans, retinal detachment, cholesterol crystals, or pathologic changes in the retinal vessels.

Examination of the right eye revealed a whitish, slightly blurred disc without distinct differentiation of the lamina cribrosa and physiologic cup. The retinal vessels were normal. A choroidal crescent was present in the temporal peripapillary area. The remainder of the examination was normal.

Visual field studies showed a moderate contraction of the central and peripheral fields to a 20-degree central field and a 40-degree peripheral field in both eyes. Test objects were a 15/1,000 white target for the right eye and a 2/1,000 white target for the left eye. X-ray films of the skull were negative.

It was felt that the exudate in the left eye was associated with the hemorrhage into the vitreous. The exact relationship was not clear. The decrease in the visual acuity in the right eye was not precisely explained but amblyopia ex anopsia seemed to be the most likely diagnosis. The patient has been followed in the eye clinic without further change in his findings.

Case 2

R. T., a 53-year-old Negress, was seen in June, 1957, when she experienced a sudden loss of vision

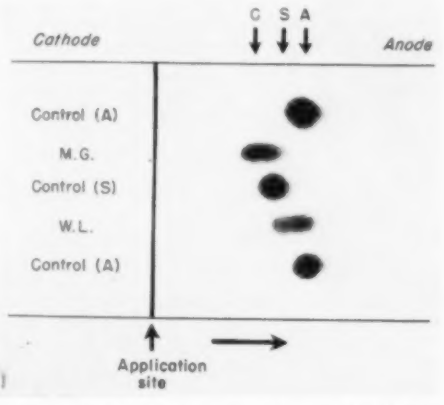

Fig. 1 (Isbey, Clifford, and Tanaka). Hemoglobin electrophoresis showed a pattern characteristic of sickle-cell trait.

in her right eye. This episode was painless and unrelated to trauma. She had been in excellent health except for a transient episode of blurring of her vision four to five months earlier and denied any bleeding tendency, either personal or familial, jaundice, crises, or other evidence of sickle-cell disease.

Her physical examination was within normal limits except for obesity, a labile blood pressure fluctuating between 150/92 to 200/100 mm. Hg, and slight left ventricular enlargement.

Her visual acuity was counting fingers at two feet in the right eye and 20/30 in the left eye. Examination of the right eye revealed a massive hemorrhage into the vitreous in the inferior quadrants and the superior nasal quadrant which obscured the macula and optic nerve. Two holes were seen in the detached retina at the 7-o'clock position. However, the extent of the retinal detachment could not be determined. The superior temporal retina showed multiple superficial retinal and preretinal hemorrhages associated with irregular patches of superficial exudate. The vessels exhibited grade one arteriosclerosis. The left eye was within normal limits except for grade one arteriosclerosis.

Central fields with a 10/1,000 white target showed a superior temporal quadrantanopsia in the right eye and a normal field in the left eye. A peripheral field of the right eye to a 15/1,000 white target revealed a contraction to 15 degrees in the superior quadrants to 40 degrees in the inferior nasal quadrant and to 30 degrees in the inferior temporal quadrants. The left eye was normal.

Laboratory examinations revealed a hemoglobin of 15.6 gm. per 100 ml., a red blood cell count of 5.63 million per cu. mm., a white blood count of 4,650 per cu. mm. with a normal differential and a hematocrit of 48 cell volumes percent. The sickle-cell preparation was positive. The platelet count was 146,000 per cu. mm., the bleeding time 3.5 (Duke), the clotting time 9.0 min. (Lee-White), and the prothrombin time 17.6 sec. with a control of 15.1 sec. The Rumpel Leede phenomenon was negative as were the routine urinalysis and serologic test for syphilis. Other studies included a blood sugar of 96 mg. per 100 ml. and a blood urea nitrogen of 17 mg. per 100 ml. Hemoglobin electrophoresis revealed a pattern characteristic of sickle-cell trait (hemoglobin A and S). The tuberculin skin test 1:10,000 was negative. Roentgenologic studies of the orbits, shoulders, and pelvis were normal while those of the chest showed minimal left ventricular enlargement.

Initial treatment consisted of vitamin C, ascorbic acid, rutin, multivitamins, pressure dressings to both eyes, and strict bedrest. During the first six weeks of hospitalization, specific details of the retina could not be seen because of the extensive hemorrhage into the vitreous but it was believed that a detachment of the retina extended from the inferior nasal to the inferior temporal quadrants. A radioactive phosphorous (P^{32}) study was negative. The patient was started on 100 u. ACTH gel daily during the seventh week and continued on this dosage for 13 days, being discharged on 20 mg. prednisolone daily.

While investigating the etiology of the patient's hypertensive cardiovascular disease, a urine culture produced E. coli sensitive to broad-spectrum antibiotics and an intravenous pyelogram revealed a normal left kidney but evidence of a chronic infection on the right. Since then, bacteriologic examination of 24-hour urine collections have been negative for all organisms including mycobacterium tuberculosis.

On the second clinic visit since her discharge, her visual acuity had improved from counting fingers at two feet to 20/40—2 in the right eye. There was marked clearing over the superior temporal quadrant, the disc, and the macula. The latter two appeared normal. The remaining quadrants were still obscure and the left eye was unchanged from the initial examination.

Case 3

T. W., a 38-year-old Negro, was first seen in June, 1956, when he experienced a sudden decrease of his visual acuity to hand movements in the left eye. This followed three weeks of intermittent blurring of his vision and seeing black spots in his field of vision. These episodes were painless and unrelated to trauma. His past history revealed that he had been in excellent health and denied hemorrhagic phenomena, jaundice, joint pains, crisis, or bleeding tendencies either personal or familial.

His physical examination was within normal limits except for multiple pigmented keratic precipitates, a two-plus flare, and cells in the anterior chamber, and an extensive vitreous hemorrhage in the left eye. The hemorrhage prohibited examination of the retina except for the periphery of the nasal quadrants where irregular deposits of pigment could be seen through the vitreous hemorrhage. His visual acuity was 20/400 in the left eye and 20/20 in the right eye. Examination of the right eye revealed many pigmented and nonpigmented keratic precipitates. The anterior chamber was free of flare and cells. Funduscopy was normal except for increased pigmentation and strands of preretinal exudate extending into the vitreous in an area temporal to the macula.

Laboratory examination revealed a hemoglobin of 14.6 gm. per 100 ml., a red blood cell count of 5.19 million per cu. mm., a white blood count of 5,900 per cu. mm. with a normal differential, and a platelet count of 368,000 per cu. mm. The sickle-cell preparation was positive, the sedimentation rate 6.0 mm. in one hour, the bleeding time 1.0 min. (Duke), clotting time 15 min. (Lee-White), and prothrombin time 14.0 sec. with a control of 15.5 sec. Other laboratory tests included a normal urinalysis and negative serologic test for syphilis.

The fasting blood sugar was 68 mg. per 100 ml., and a blood urea nitrogen of 16 mg. per 100 ml. Hemoglobin electrophoretic pattern of sickle-cell trait (hemoglobin A and S). The tuberculin skin test 1:10,000 was negative.

His treatment consisted of strict bedrest, pressure dressings, sedation, rutin, ascorbic acid, and parenzyme. Within 12 days a detailed examination

of his fundus could be performed by direct and indirect ophthalmoscopy. Fifteen holes were localized at the 2-, 4-, and 10-o'clock positions in the detached retina which extended from the 1-o'clock to the 10-o'clock positions. The holes in the retina were associated with circumscribed areas of preretinal exudate and inactive chorioretinitis. On the 14th day of hospitalization 500 ml. of blood were administered and a scleral resection with partially penetrating diathermy was done in the area of the detachment on the 15th day. The patient maintained a stable postoperative course but the vitreous remained clouded with hemorrhage. He was discharged on limited activity three weeks following surgery.

In July, 1957, an adequate funduscopic examination could be performed. Prior to that time the vitreous was too hazy. The retina was reattached in all quadrants and the vitreous was clear of hemorrhage. The right eye was essentially unchanged. His visual acuity was 20/30 in the right eye with a −0.75D. sph. ⊃ +2.5D. cyl. ax. 90° and 20/40 in the left eye with a −1.0D. sph. ⊃ +2.25D. cyl. ax. 45°.

CASE 4

P. J., a 19-year-old Negress, was seen in July, 1957, when she noticed blurring of vision in her left eye. This was entirely painless and unrelated to trauma. She had been in excellent health and in her third month of pregnancy. A review of her past history was essentially negative except for a miscarriage in 1956 following a normal pregnancy. She denied any bleeding tendency, personal or familial, jaundice, crisis, or other evidence of sickle-cell disease.

Her physical examination was within normal limits except for an intrauterine pregnancy of three months. Her visual acuity was 20/20 in the right eye and 20/40 in the left eye. The right eye was normal on examination.

Funduscopic examination of the left eye revealed a normal optic disc except for a few minute superficial retinal hemorrhages at the temporal margin. In the periphery of the superior temporal quadrant there were a few deep retinal hemorrhages while in the inferior temporal and inferior nasal retinal quadrants scattered preretinal hemorrhages could be seen. Temporal to the macula a sceptor-shaped grayish retinal fold was seen. The whole inferior quadrant of the retina appeared gray, edematous, and elevated. However, there were no holes or tears in the retina to suggest a detachment. The vessels were normal.

Laboratory examination revealed a hemoglobin of 12.6 gm. per 100 ml., a red blood count of 4.61 million per cu. mm., a white blood count of 5,000 per cu. mm. with a normal differential, and a hematocrit of 37 cell volumes percent. The sickle-cell preparation was positive. The platelet count was 316,000 per cu. mm., sedimentation rate 65 mm. in one hour, bleeding time 4.5 min. (Duke), clotting time 13 min. (Lee-White), and the prothrombin time 17.8 sec. with a control of 11.5 sec. The routine urinalysis showed a few white and red blood cells on microscopic examination. The serologic test for syphilis was negative. Other studies included a blood sugar of 96 mg. per 100 ml. and a blood urea nitrogen of 20 mg. per 100 ml. Hemoglobin electrophoresis revealed a pattern characteristic of sickle-cell trait (hemoglobin A and S). The tuberculin skin test 1:10,000 was negative. Roentgenographic studies of the orbit and chest were normal.

Initial treatment consisted of bedrest, pressure dressings, multivitamins, rutin, and ascorbic acid. As the edema of the inferior retina subsided, a diffuse area of chorioretinitis was seen in the periphery of the inferior temporal quadrant. Adequate examination of this lesion was obscured by the hazy vitreous. Within 10 days the retina appeared to settle and the patient was discharged on limited activity. Since then her visual acuity has returned to 20/20 in the left eye. Detailed examination of the inferior retina is still prohibited. The right eye has remained normal.

CASE 5

M. G., a 37-year-old Negress, was first seen in the Ophthalmology Out-patient Clinic in October, 1956, with the history of blindness of the right eye secondary to vitreous hemorrhage since December, 1955. Her past history revealed that, since the age of five years, she had had recurrent bouts of fever followed by nausea, vomiting, and aching pains in the middle of her extremities occurring every two to three months until the age of 20 years. Subsequently the pains had occurred once or twice a year.

In 1949, a right nephrectomy had been performed at another institution because of frequent bouts of hematuria and backache. She had been told that she had sickle-cell anemia. She also stated that, in 1950, a hemorrhage in her left eye had been treated with good results. In 1953, she had been hospitalized for hematuria. Upon recovery she had remained asymptomatic until December, 1955, when hemorrhage occurred spontaneously in her right eye, resulting in a visual acuity reduced to light perception.

In October, 1956, her vision was hand movements only in the right eye, and the fundus could not be visualized. The left eye was normal except for vitreous opacities inferiorly. Her vision was 20/20 in this eye. In November, 1956, she noticed sudden dimness of vision and spots before her left eye. On admission her visual acuity was hand movements in her right eye and 20/400 in her left eye. Central and peripheral fields of vision of the left eye revealed constriction to 10 degrees in the superior quadrants and inferior nasal quadrant. Test objects were a 3/1,000 white for the peripheral field and 5/1,000 white for the central field. Examination of the right fundus was obscured by opacities in the vitreous while the left fundus, although hazy, revealed hemorrhages centrally and in the temporal and inferior quadrants of the vitreous. The foveal reflex was present. White fibrous bands were seen extending vertically in the nasal

quadrants. No abnormal arrangement of the peripheral vessels was noted. The remainder of the physical examination was not remarkable.

Subsequent hemoglobin electrophoresis established the presence of both hemoglobin S and C (fig. 1). Laboratory examinations revealed a hemoglobin of 14.0 gm. per 100 ml., a red blood cell count of 4.98 million per cu. mm., a white blood cell count of 10,200 per cu. mm. with a normal differential, a hematocrit of 46 cell volumes percent, and reticulocyte count of two percent. The sickle-cell preparation was positive. The sedimentation rate was two mm. in one hour, bleeding time 4.5 minutes, clotting time six minutes, platelet count 309,000 per cu mm., and prothrombin time 15 seconds with a control of 14.2 seconds. The prothrombin consumption test was normal. Other laboratory tests included a blood urea nitrogen of 11 mg. per 100 ml., a blood sugar of 78 mg. per 100 ml., and a normal urinalysis. The tuberculin skin test 1:10,000, as well as roentgenologic examination of the chest and long bones, was negative.

Over a two-week period the vitreous hemorrhage began to clear on strict bedrest and high vitamin K, ascorbic acid, and rutin supplements, although it was felt that little could be expected of these agents. When she was discharged, her visual acuity was 20/20 in her left eye but she returned five days later with recurrent hemorrhage into the vitreous and a visual acuity of hand movements in the left eye. After four weeks of hospitalization she was discharged with a visual acuity of 20/30. In eight weeks her vision was 20/20 but her fundus displayed increased density in the inferior portion of the vitreous.

In February, 1957, she was rehospitalized with a new vitreous hemorrhage in the left eye and a visual acuity of hand movements. Upon discharge nine days later she had light perception in the right eye and could count fingers at five feet with the left eye. In March, 1957, her vision was 20/20—2 in the left eye; the right eye was unchanged. The left fundus could be more easily examined than at any time prior to October, 1956, and it revealed diffuse haziness and retinitis proliferans. This began nasally and extended from the superior retina across the superior border of the lens. In the inferior temporal quadrant of the retina there were patches of exudate adjacent to an area of increased pigmentation. This was felt to be a localized area of chorioretinitis. Inferiorly there was a dark organized mass which was felt to be an exudative retinitis with elevation and edema of the retina. The vitreous showed white opacities in the peripheral temporal area. No abnormal vascular pattern was seen on direct or indirect ophthalmoscopy. The right fundus was not visible, but marked retinitis proliferans extending into the vitreous from the temporal quadrant of the retina was present. Large vitreous opacities were seen. Currently she is being followed in the clinic, and has maintained 20/20 vision in the left eye. Surgery was not advised on the left eye because of the extensive involvement.

CASE 6

W. G., a 39-yar-old Negro, was first seen in April, 1954, because he had awakened from a nap to find that vision in his right eye was restricted to light perception only. There was no history of trauma. His vision had been 20/20 at the time of his last examination in 1950. His past history revealed that after the removal of a semilunar cartilage in 1943, he had been hampered by unpredictable buckling of the right knee, but there had been no recent fall. He denied hemorrhagic phenomena, jaundice, joint pains, and crises. He had no personal or family history suggesting sickle-cell anemia or its variants.

His physical examination upon admission was within normal limits except for massive hemorrhage in the right eye resulting in light perception only. His vision was 20/70 in the left eye; pinhole vision was 20/40. Vitreous opacities were present and the retina appeared normal except for a small lesion, described as choroiditis, inferiorly.

Treatment consisted of bedrest, vitamin K, ascorbic acid, and rutin supplements. After 10 days of hospitalization, he was discharged with his vision improved in the right eye to counting fingers at three feet. In May, 1954, he was readmitted because of failing vision in his left eye which may have followed a fall. Examination of the left eye at this time revealed fresh vitreous hemorrhages, white retinal exudates, and retinitis proliferans. The right fundus could not be visualized. The visual acuity was 20/200 in the right eye and counting fingers at three feet with the left eye. During his hospitalization a retinal detachment associated with the retinitis proliferans possibly occurred.

Laboratory examinations revealed a hemoglobin of 14.0 gm. per 100 ml., a red blood cell count of 4.89 million per cu. mm., a white blood cell count of 10,000 per cu. mm., a normal differential, a hematocrit of 51 cell volumes percent, and reticulocyte count of 0.8 and 0.5 percent. The sickle-cell preparation was positive. The sedimentation rate was five mm. in one hour, bleeding time 3.5 min., clotting time 7.5 min., platelet count 303,000 per cu. mm., prothrombin time 15.5 sec. with a control of 14.9 sec., and serum bilirubin 0.4 mg. per 100 ml. Other laboratory tests included a normal glucose tolerance and negative febrile agglutinations.

A hemolytic index of 33 (normal 11 to 21) was derived from the fecal urobilinogen excretion of 270 mg. per 24 hours and suggested that slightly accelerated hemolysis was occurring. Several blood smears exhibited target cells, and the osmotic fragility test demonstrated beginning hemolysis in 0.45-percent saline and complete hemolysis in 0.20-percent saline. Mechanical fragility was normal under oxygen but increased under CO_2 (31 percent). The bone-marrow examination revealed accelerated erythrocytogenesis consistent with a hemolytic process. Paper electrophoresis demonstrated the presence of hemoglobin S and C. Roentgenologic examinations of the skull, chest, and hands were

normal. The tuberculin skin test 1:10,000 was negative.

His treatment was essentially the same as previously, except that ACTH, 20 units every six hours, was given for 10 days. His vision improved in both eyes to 20/25—2 in the right eye and 20/30—2 in the left eye. After his discharge in July, 1954, he was not seen until November, 1954, when his vision had improved to 20/20 in both eyes. The vitreous hemorrhage had not absorbed, and no retinal detachment was seen.

In January, 1957, he was admitted to another hospital with sudden loss of vision in his right eye. A diagnosis of Eales' disease with retinal detachment in the temporal quadrants was made and after a scleral resection operation for the detachment he did poorly but maintained light perception in the eye. Systemic steroids were not helpful.

In April, 1957, he was admitted to the Veterans Administration Hospital, Dearborn, Michigan, with a visual acuity of light perception in the temporal quadrant of the right eye and 20/20 without correction in the left eye. The right eye showed phthisis bulbi and the left eye manifested vitreal opacities, perivascular exudates, and retinitis proliferans. An uneventful enucleation of the right eye was performed and histologic sections at the Kresge Eye Institute showed marked perivasculitis of the retinal vessels. The significance of this could not be ascertained because of the recent retinal detachment and scleral resection. The sickle shape of the red blood cells could be seen clearly within the retinal vessels, but a thrombus of sickle cells could not be demonstrated.

In May, 1957, he was examined in our clinic. The visual acuity was 20/20+2 in the left eye and examination of the fundus revealed a dense band of scar tissue along the superior temporal arteriole and venule and extending in butterfly fashion into the vitreous. At the 1-o'clock position in the periphery two branches of the superior temporal arteriole were occluded and extending from the sides of occlusion were bands of retinitis proliferans. Distal to the bands was an organized preretinal hemorrhage. A similar picture was present inferiorly while nasally there was retinitis proliferans in the inferior quadrant. The disc and macula were normal. A few opacities in the vitreous could be seen.

Visual field studies showed a 25 degree central field to a 1/1,000 white target and a contraction of 15 degrees in the peripheral field to a 3/1,000 white target.

The patient was advised to have surface diathermy but was reluctant to accept the advice. He is currently being followed in our clinic and has had no change in his eye.

Case 7

J. W., a 37-year-old Negro, was seen in May, 1957, when he noticed increased blurring in his vision beginning in April, 1957. This process was painless and unrelated to trauma. He had been in excellent health and had not had an examination of his eyes. He denied any bleeding tendency either personal or familial, jaundice, crises, or other evidence of sickle-cell disease.

His physical examination was entirely within normal limits except that his vision was 20/400 in his right eye and 20/100 in his left eye. Examination of both eyes showed markedly blurred retinas with irregular patches of preretinal hemorrhage temporally in the right eye and nasally in the left eye. Later both retinas could be seen more clearly and there was noted a veil of preretinal glial tissue extending over the macula one disc diopter from the optic disc in the right eye while temporally in the periphery there was considerable organized exudate in the vitreous and preretinal area. Two tears in the retina could be seen, one at the 2-o'clock position and the other at the 5-o'clock. The disc was normal.

The left eye revealed organized preretinal exudate from the 6-o'clock to the 12-o'clock positions and the retina appeared attached in all quadrants. The disc was normal but the macula was blurred and a poor foveal reflex existed.

Laboratory examinations revealed a hemoglobin of 14.2 gm. per 100 ml., a red blood count of 5.0 million per cu. mm., and a white blood count of 7,800 per cu. mm. with a normal differential. The hematocrit was 50.5 cell volumes percent and the reticulocyte count 11.6 percent. The sickle-cell preparation was positive. The platelet count was 400,000 per cu. mm., bleeding time three min. (Duke), clotting time 11 min. (Lee-White), and prothrombin time 14.0 sec. with a control of 13.0 sec. The prothrombin consumption test was normal. Osmotic fragility showed initial hemolysis in 0.45-percent saline, and complete hemolysis in 0.15-percent saline. The Rumpel Leede phenomenon was negative as were the routine urinalysis and serologic test for syphilis. Other studies included a blood sugar of 90 mg. per 100 ml. and a blood urea nitrogen of 13 mg. per 100 ml. Hemoglobin electrophoresis revealed a pattern characteristic of sickle-cell hemoglobin-C disease (hemoglobin S and C).

Roentgenologic studies of the chest were normal but studies of the pelvis revealed areas of increased density in the right femoral head and probably the left femoral head, compatibile with aseptic necrosis. Skin tests to toxoplasmin, brucellergin, coccidiodin, blastomycin, histoplasmin, and tuberculin 1:10,000 were negative. Osteoarthritic changes were present in the lumbar spine. Central fields (with a 15/1,000 white target) revealed concentric contraction ot 15 degrees in the left eye and 10 degrees in the right eye. Peripheral fields with a 20/1,000 white target reevaled irregular areas of contraction to approximately a 20-degree isopter in both eyes.

The patient was treated seven days with ACTH, penicillin, streptomycin, microwave diathermy, multivitamins, and atropine for a posterior uveitis. However, when the diagnosis of sickle-cell hemoglobin-C disease was established this therapy was

TABLE 1

REVIEW OF CASES

Case	Age	Race	Sex	Hemoglobin Pattern	Involvement-Site	Involvement-Extent
1. W. L.	39	Negro	M	AS	O.S.	Minimal vitreous opacities
2. R.T.	53	Negro	F	AS	O.D.	Extensive vitreous hemorrhage and retinal detachment
3. T. W.	38	Negro	M	AS	O.S.	
4. P.J.	19	Negro	F	AS	O.S.	Retinal and vitreous hemorrhage and retinal edema
5. M.G.	37	Negro	F	SC	O.U.	Severe retinitis proliferans
6. W.G.	39	Negro	M	SC	O.U.	Retinal detachment
7. J.W.	37	Negro	M	SC	O.U.	Vitreous opacities

discontinued and rutin and ascorbic acid were used. His visual acuity had improved to 20/30 in both eyes when the patient requested discharge. He refused surface diathermy to the right eye and due to his unco-operative attitude he has been seen only three times since his discharge. At his last visit his vision was hand movements in the right eye and 20/200 in the left eye. The fundi were essentially unchanged.

Pertinent clinical data of these patients are summarized in Table 1.

Discussion

Sickle-cell trait is usually considered to be a benign condition. On theoretic grounds and in certain situations the presence of the sickling phenomenon might predispose the individual to thrombotic occlusions and hemorrhagic episodes. In fact, these episodes have been shown to occur spontaneously, resulting in bouts of painless hematuria and splenic infarction due to low oxygen tension while flying. Though spontaneous vitreous hemorrhage has heretofore been reported only once in sickle-cell trait, its occurrence may be anticipated for the reasons already listed. We feel that our cases illustrate this possibility. However, since large groups of Negro patients with spontaneous vitreous hemorrhage have never been studied, a possible correlation between hemorrhage into the vitreous and sickle-cell trait has not been determined. Of course, we are unable to exclude possible co-existence of other disorders to explain our cases but we feel that an etiologic relationship is highly probable.

In addition to the cases reported here we have seen a 14-year-old Negro girl and an 11-year-old Negro boy with sickle-cell trait, each of whom had sustained trauma to the right eye and developed vitreous hemorrhage. The role of sickle-cell trait in these cases is uncertain but it may have been a predisposing factor to the vitreous hemorrhage.

Spontaneous vitreous hemorrhage would appear to be more common in sickle-cell hemoglobin-C disease than sickle-cell trait but a factor of selection may operate to call attention to these patients since the presence of anemia, splenomegaly, mild icterus, and so forth, may raise the possibility of an associated blood dyscrasia. Nonetheless, only 10 cases of this lesion in sickle-cell hemoglobin-C disease have been reported in the American literature to date.[2,5] Three additional cases are included in the present report. Henry and Chapman[7] reported several cases of vitreous hemorrhage associated with sickle-cell disease, but hematologic data were insufficient to permit accurate classification of these cases into sickle-cell anemia as against its milder variants.

Hemorrhage into the vitreous of various etiology has been reported to be associated with disturbances of the intraocular vascular network.[13,14] Spontaneous hemorrhages into the vitreous without apparent etiology have often been classified as undiagnosed or as Eales' disease.[13,15,16] Until recently, little attention has been given to the association

of spontaneous vitreous hemorrhage with sickling of the red blood cells.

In our case material all seven patients experienced spontaneous vitreous hemorrhage without antecedent trauma. Routine and special coagulation studies revealed no evidence of a disorder of blood coagulation. The patients had not experienced ocular surgery at any time. No known congenital, familial, infectious, degenerative, or systemic disease was found except for sickling of the red blood cells and the abnormal hemoglobin patterns. Roentgenologic examination of the chest, tuberculin skin tests, and examination of the fundus ruled out a possible etiologic relationship with tuberculous periphlebitis of the retina. Also, direct and indirect ophthalmoscopy did not reveal a thrombosis of the central retinal vein or of a peripheral venule to account for the vitreous hemorrhage.

It has been suggested[7] that the presence of hemorrhage into the vitreous in individuals whose red blood cells sickle may reflect a change in the retinal capillary bed secondary to thromboses formed by the abnormally shaped cells. While erythrocytes of normal contour pass through the retinal capillaries without difficulty, sickled cells are rigid and inflexible, and they may become impacted in the smaller capillaries and produce stasis with thromboses and hemorrhage. It is suggested that once this process starts, a cycle of recurring retinitis proliferans and vitreous hemorrhages develops and produces further damage to the eye.

Verhoeff[17] discussed this theory while presenting a case of successful diathermy in a patient with recurring retinal hemorrhages and retinitis proliferans. He felt that the hemorrhages resulted from the engorgement of the capillaries and the small veins. When this engorgement was severe and persistent, new vessels were formed which extended into the vitreous and, at the same time, hemorrhage into the vitreous occurred. The extravasated blood may stimulate endothelial cell proliferation and neovascularization producing retinitis proliferans. Usually the lesions are large, round, or irregular retinal hemorrhages and are confined to the periphery of the retina near the veins. The visual loss is proportionate to the vitreous opacification which frequently clears between attacks.

Conjunctival icterus, engorgement of the retinal venules, and ocular signs secondary to central nervous system involvement have been described in sickle-cell anemia, but no characteristic ocular lesion is known.[18] Hannon[6] recently described anomalies of the retinal vascular tree which he felt were diagnostic of sickle-cell hemoglobin-C disease. These anomalies had the appearance of a neovascular anastomotic network of fine vessels apparently in relation to venules in the peripheral temporal quandrant. He felt that these were the earliest vascular abnormalities. Later, twisted, corkscrewlike venules appeared, arranged in a multiple arborizing fashion with terminal dilatations appearing to extend into the vitreous and were presumably the site of the ultimate hemorrhage. Multiple occlusions of venules and arterioles were also seen.

Since none of our cases exhibited this anomalous vascular pattern, we cannot corroborate this finding. However, it seems possible that this peculiar pattern is compatible with Verhoeff's observation that new vessels are formed in association with severe and persistent engorgement of the retinal venules. If we are to accept Verhoeff's explanation for the pathogenesis of vitreous hemorrhage and if the sickling of the red blood cells is the basic factor, we would expect an increased incidence of vitreous hemorrhages in sickle-cell disease and especially so in sickle-cell anemia, which generally has the greatest incidence of complications associated with the sickling process. However, vitreous hemorrhages have apparently not been reported in sickle-cell anemia.

At present, no successful method of treatment has been discovered. Surface diathermy has been used successfully in a few

cases[6] but its use is relatively limited and improvement may have been only coincidental. If the sites of hemorrhage are well localized, normal vision may be preserved for an unknown period of time but, if they are diffuse or if the eye is in a far-advanced stage, the prognosis is poor. The steroids have proved valueless. At best, bedrest appears to be the most important factor. This permits normal absorption of the hemorrhage. Though it is probably only coincidental, it is interesting to note that the majority of our patients were in their late 30s. However, the ages ranged from 19 to 53 years in our case material.

It appears that spontaneous vitreous hemorrhage may occur in relation to the sickling process without other apparent etiology. This suggests that some of the patients considered to have Eales' disease may have as an etiology some form of sickle-cell disease or its variants. This complication should be considered in Negro patients who present with spontaneous vitreous hemorrhage, and a sickle-cell preparation and hemoglobin electrophoresis, if the former is positive, should be performed.

Summary

Seven cases of spontaneous vitreous hemorrhage in association with the sickling process have been presented. Four patients had sickle-cell trait and are added to a single case previously described in whom such an ocular manifestation occurred in the presence of this hemoglobin type. Three patients with the association of spontaneous vitreous hemorrhage and sickle-cell hemoglobin-C disease are also reported. It is suggested that this complication is more frequent than reports in the literature would indicate.

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Addendum

Recently Goodman et al. (Arch. Ophth., **58**:655, 1957) described the ocular findings in four cases of sickle-cell hemoglobin-C disease and one case of sickle-cell hemoglogin-D disease. Their observations were similar to ours.

Acknowledgment

We wish to acknowledge the criticisms and suggestions of Dr. Windsor S. Davies and Dr. Albert D. Ruedemann, Department of Ophthalmology, Wayne State University College of Medicine, and to thank Miss Zora Kingson, M.T. (A.S.C.P.), for her technical assistance.

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PTERYGIUM EXCISION

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The purpose of this paper is not to review the different techniques for the excision of pterygium but to report on a technique that I have used in many cases with good results.

Because of their frequency, their size at the time patients come under my care, and, in some cases, the difficulties set up by their repeated recurrences, pterygiums present many problems. Prior to using the technique here reported, I had used the McReynold's procedure, buccal mucosa grafts, corneal grafts, and different procedures of excision with sliding or free conjunctival flaps. None of them has been completely satisfactory.

TECHNIQUE

The operation is in two main stages: (A) The total removal of the pterygium; (B) the plastic repair of the conjunctiva.

A. FIRST STAGE

The pterygium must be totally excised to a point near the caruncle (fig. 1).

a. The head of the pterygium is shaved from the cornea with a sharp knife, removing with it the superficial corneal layers up to the limbus.

b. From the upper and lower edge of the pterygium at the limbus, two incisions are made in the conjunctiva converging to a point just temporal to the center of the plica, or of the caruncle if the plica has disappeared. With a cotton sponge, the conjunctiva is pushed upward, medially, and downward as far as possible.

c. Picking up the head of the pterygium, the subconjunctival tissue is blunt dissected with scissors down to the bare sclera and as far superiorly, medially, and inferiorly as possible. The tissue thus dissected is totally excised with scissors (fig. 2). Care should be taken here so as not to injure the internal rectus muscle. Bleeding vessels in the sclera, muscle, or subconjunctival tissues are carefully cauterized.

B. SECOND STAGE

Conjunctival repair. The total excision thus far performed leaves a conjunctival defect of a dimension that depends upon the size of the pterygium. Its closure can be carried out in different ways but two basic principles must be kept in mind: (1) Healthy conjunctiva must be brought in to cover the defect; (2) an area of bare sclera

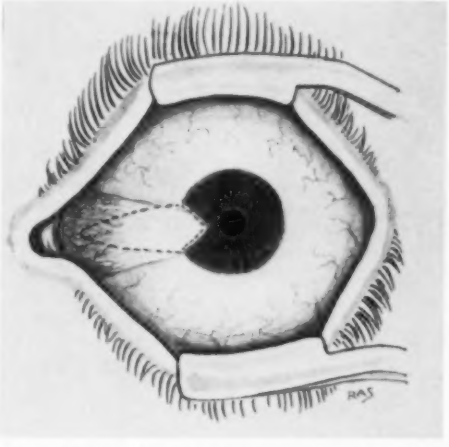

Fig. 1 (Escapini). This shows the lines of excision from the cornea and the conjunctival incisions.

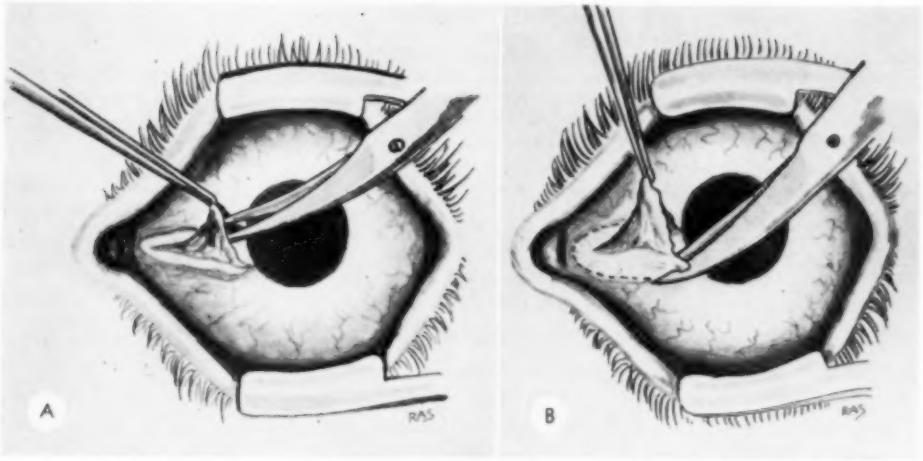

Fig. 2 (Escapini). The subconjunctival tissue is generously dissected and excised.

must be left between the edge of the conjunctiva and the limbus.

a. Small defect (fig. 3). When the pterygium is small, its excision leaves a small bare area, which is very simple to repair. The conjunctiva is undermined upward and downward, and its borders sutured together with interrupted 6-0 catgut. The first suture is placed four mm. from the limbus and anchored to the superficial sclera, leaving a triangular bare area.

b. Medium sized defect (fig. 4). This requires the dissection of a conjunctival flap, which is pulled down to cover partially the defect. A 6-0 catgut suture is passed near the border of the conjunctival defect and through the superficial sclera, three mm. from the limbus at (a). A 10-mm. incision is made in the upper conjunctiva, slightly slanting upward and outward, four mm.

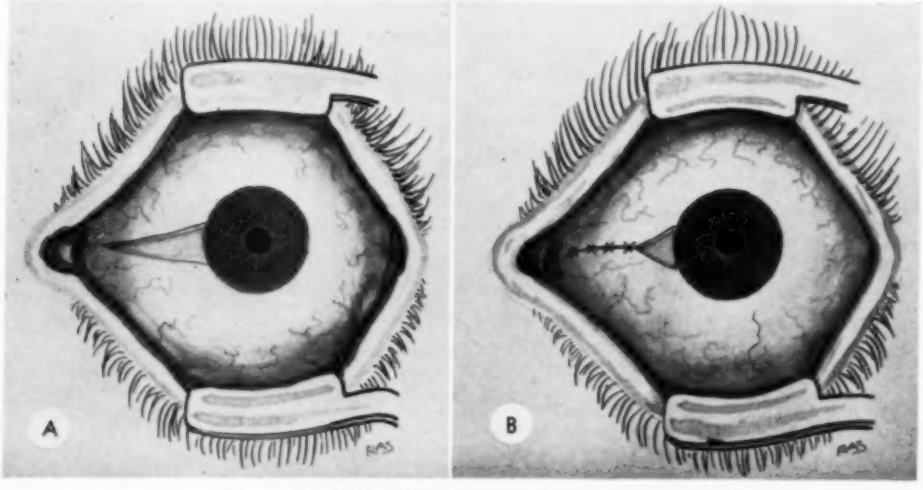

Fig. 3 (Escapini). Conjunctival repair of a small defect.

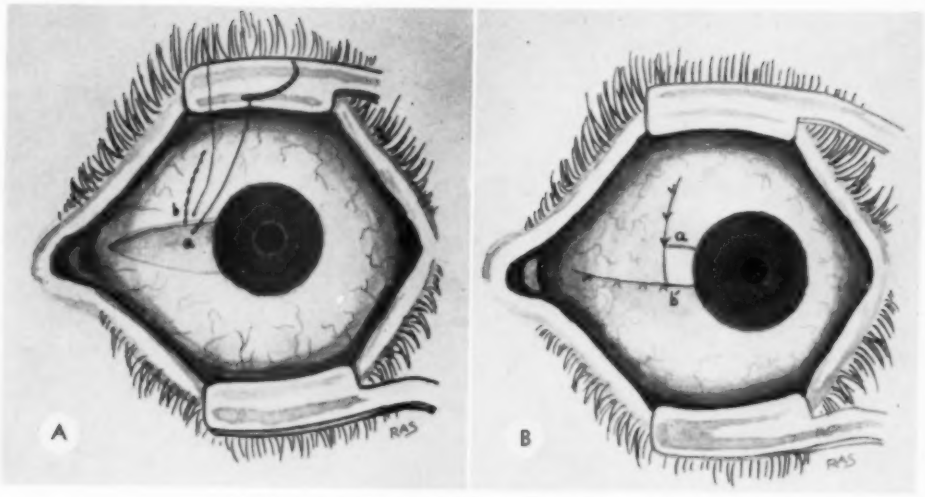

FIG. 4 (Escapini). Repair of a medium-sized defect.

from the limbus and the conjunctival flap (b) is undermined. The tip of this flap is fastened to the episclera and the suture is passed through the lower conjunctival border three mm. from the limbus at (b'). Several more sutures are placed to join the flap to the lower conjunctiva. The suture at (a) is now passed through the edge of the conjunctival flap to anchor it to the episclera; two or more sutures are placed above to close the conjunctival wound. A rectangular area of bare sclera is left.

c. Large sized defect (fig. 5). This requires the dissection of two conjunctival flaps. The conjunctiva at (a) and (b) is anchored to the superficial sclera with 6-0

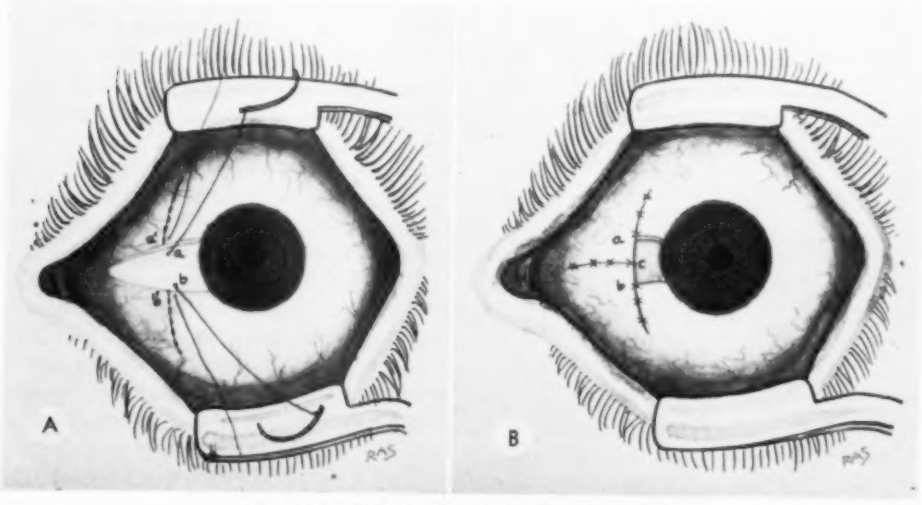

Fig. 5 (Escapini). Repair of a large-sized defect.

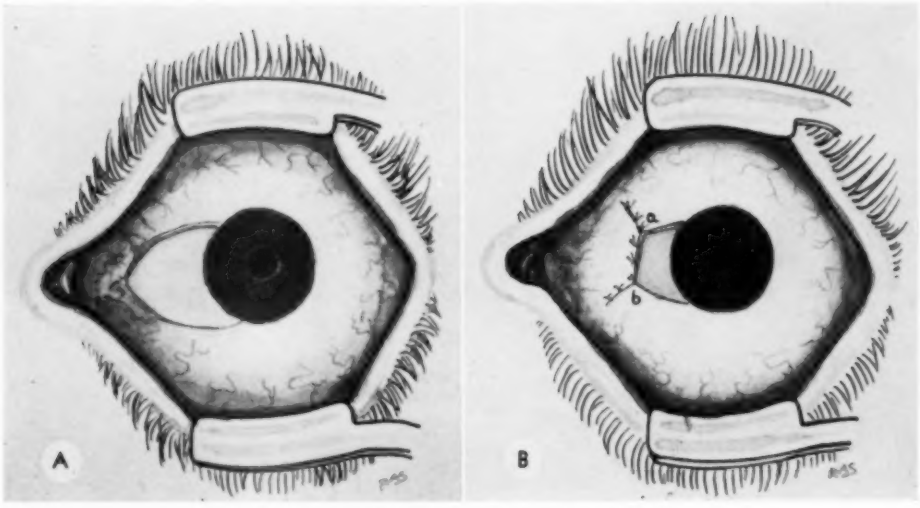

Fig. 6 (Escapini). Repair of a very large defect.

catgut, three mm. from the limbus. Two 10-mm. long conjunctival incisions are made four mm. from the limbus; the upper one slants upward and outward and the lower one, downward and outward. The two conjunctival flaps (a′) and (b′) thus outlined are undermined. A double-armed 6-0 catgut suture is passed through the superficial sclera on the horizontal meridian, three mm. from the limbus at (c), and each of its needles is passed through the tip of the conjunctival flap in order to anchor them to the sclera. At (a) and (b) the sutures are passed through the border of the conjunctival flap to fasten them to the sclera. Several more sutures are placed in the horizontal and vertical incisions. A rectangular area of bare sclera remains.

d. Very large defect (fig. 6). There are cases of huge pterygiums, the excision of which leaves very large conjunctival defects that make the dissection of conjunctival flaps impossible. In these cases, the nasal border of the conjunctiva is brought forward as far as possible and anchored to the sclera at (a) and (b). Several additional sutures are placed to close the conjunctiva.

Results

In the last two years, I have operated upon several hundred eyes of which 184 in 142 patients were studied for this report.

The eyes remained congested for two or three weeks subsequent to the operation. The use of hydrocortone drops hastened the whitening of the eye. Some eyes were white around the 10th day.

Of the 184 eyes operated upon, it was a primary operation in 180. The four remaining had recurrent pterygiums. There were two recurrences in those operated upon for the first time. In the recurrent group, there were also two recurrences; both had been operated upon by another surgeon using a different technique, twice in one and seven times in the other.

Whenever a recurrence is going to develop, the eye remains congested and within two months the new growth starts to invade the cornea. When there will be no recurrence, the eye is white within two weeks to a month. All the patients in this report have been observed for no less than two months and, some, several months to a year.

I believe that a pterygium that has not

shown a tendency to recur within the first month will not recur.

The use of hydrocortone does not prevent recurrence. Those cases in which recurrence occurs were using the steroid several times a day. On more than one occasion, a clouding without blood vessels developed at the site of the pterygium in spite of the use of hydrocortone drops.

Summary and Comment

A technique for surgical treatment of pterygium has been described. It is surgically sound because: (a) It removes all diseased tissue, conjunctival as well as subconjunctival; (b) normal conjunctiva is brought in to cover the defect left by the excision of tissues; (c) an area of bare sclera is left between the limbus and the edge of the conjunctival flap.

The three outstanding features of the technique have been individually advocated by different surgeons in order to decrease the tendency to recurrence. I believe that the three together increase the chances of a permanent cure of pterygium.

In principle all pterygiums should be operated upon, with the exception of those small noncongestive types, occurring in elderly people, that have shown no tendency to progress over a period of years. The earlier the operation is performed, the better the result will be. Nasal and temporal pterygiums are treated alike.

All the patients herein reported have been operated upon by me in order to keep the operating technique and skill standard. Of the 180 cases analyzed for this report in which the operation was a primary procedure, there were only two recurrences.

Prior to the technique described here, I had used several less successful surgical procedures for different periods of time. I was constantly searching for a technique that would give a more permanent result.

OPHTHALMONEUROLOGIC SYMPTOMS CAUSED BY LESIONS OF THE FRONTAL LOBES*

A clinical and experimental study

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Certain ophthalmoneurologic symptoms have been noted both in patients who have undergone a brain operation and experimental animals. Among the authors especially interested in the study of the frontal lobe centers should be mentioned Sherrington, Fulton, Clark, Le Gros, Hess, Penfield, Rassmussen, and others. These authors have contributed greatly to the knowledge of the function of the frontal cortical centers and of the association between the frontal cortex and the subcortical centers.

In previous studies[1] (Arch. Ophtal., 1956) the anatomic and physiologic connections between the eye, diencephalon, thalamus, and frontal areas were discussed. It was concluded that, from the standpoint of ophthalmologists, prime importance must be attached to the frontal area (Brodmann,[8,9,10] the orbital areas 13 and 14 and area 24), the site of the anterior cingulate gyrus. It must be borne in mind that, according to Fulton, in addition to other associated paths to the frontal cortex, there are corticopetal connections with the thalamus over the anterior thalamic nuclei and the dorsomedial thalamic nuclei. The hypothalamic nuclei, therefore, project themselves as far as the frontal cortical centers, and the dorsomedial

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thalamic nuclei represent a kind of relay station between the frontal cortex and the hypothalamus. The anterior cingulate gyrus is linked to the hypothalamus by the anterior thalamic nuclei (McCullock, 1948).

The frontal areas of the brain have been studied clinically for neurovegetative effects, especially in schizophrenics where the operation involved the frontal part of the brain. In addition to this area, the fronto-orbital portion of the brain is of considerable interest in the analysis of ophthalmologic symptoms.

Experiments on dogs, cats, and monkeys have shown that an electric stimulus of orbital area 13 causes changes in respiration and blood pressure. These two effects have likewise been observed to be independent of each other (Sachs, Brendler, 1949). When there was any stimulus of the orbital area and of the anterior perforated space, it was also possible to observe a dilation of the pupil, conjugated movements of the eyeball, and lacrimation.

More than 50 years ago, W. G. Spencer (quoted by Fulton) observed in cats, dogs, rabbits, and monkeys that an electric stimulation of the orbital cortex caused changes in respiration and blood pressure. According to these observations it was considered that the orbital gyrus represented the main cortical center of the vagus nerve (Bailey, Swett, 1940). According to Hess, the autonomic effects (after stimulation by implanted electrodes) consisted of movements of the mouth with salivation, rise and fall of blood pressure, and depression and acceleration of respirations. At the same time it was possible to observe movements of the muscles of the mouth, face, throat, and hands; these occurred contralaterally and ipsilaterally and in the form of cycles (Hess, McDonald, Akert, 1951). According to these authors, there were no effects in the area of the eye, excepting a movement of the eyelids.

Previous electric stimulation of the diencephalon in cats and of the medial portion of the ventral nucleus of the thalamus yielded reactions similar to those obtained when the orbital gyrus was stimulated (Hess). Therefore the orbital portion of the brain in cats was considered as the sensoric projection area for the face, mouth, throat, and nose for intra- and extraceptive sensations (Hess).

Apart from these definite electric stimuli in the frontal or orbital areas, one must also mention effects obtained after a unilateral or bilateral removal of the frontal brain. In the case of unilateral removal of the frontal brain, Penfield (1948) established nothing significant; while after bilateral gyrectomy (area 8 and area 9, posterior part; area 6, anterior part), there were no ocular symptoms except repeated automatic movements of the face and extremities, periodic mental confusion, and incontinence. Electric stimulation of the anterior cingulate gyrus provoked cardiovascular changes, tachycardia and bradycardia, pilo-erection, and dilation of the pupils (McCullock).

According to Cloake (1952), the findings in other studies of the reactions of the brain after electric stimulation of certain areas were not always identical and often contradictory. After stimulation of area 8, Livingstone (1948) never observed any dilation of the pupils, conjugated deviation of the eyes, nor lacrimation. Fulton, Hess, Vogt, Penfield and others did, however, record such findings. Furthermore, there is disagreement upon the role of the frontal cortex.

Hess, Akert, and McDonald ascribe secondary importance to that area. They describe the sensory, motor, or vegetative functions of the prefrontal area as regulatory concomitant mechanisms which are subjugated to the subcortical hypothalamic centers. According to Penfield and Rassmussen (1950), it appears that, in the hypothalamus, there are circuit neurones which have been considered the highest order of neurologic representation. However, many of these functions and laws have been built up in special areas of the cerebral cortex and it would, therefore, be erroneous to assume

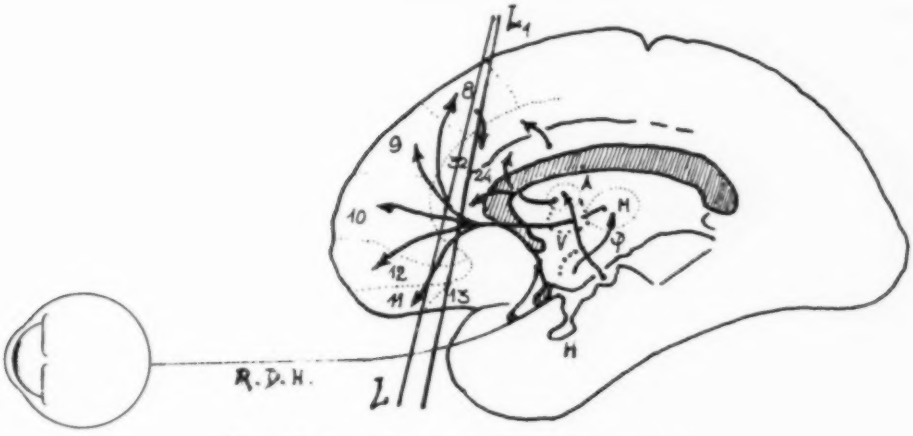

Fig. 1 (Cavka). Afferent pathways of the frontal lobe.

Re = Drawn (with modifications) after LeGros Clark.
A = Anterior thalamic nucleus.
M = Dorsomedial thalamic nucleus.
V = Mamillo-thalamic tract.
P = Periventricular system.
L = Leukotomized areas of frontal brain (transfrontal).
L_1 = Leukotomized areas of frontal brain (transorbital).
R.D.H. = Radix dorsalis hypothalamicus.
H = Hypophysis.

that the cortex belongs to a lesser order of brain activity. Hughlings Jackson considers that, apart from the diencephalon, the highest order of cerebral function may be localized in the frontal cortex. Goody and Reinhold (1954) emphasize that the function of the cortex consists in selection, abstraction, and integration of the motion pattern of cerebral activity.

Histopathologic findings of brain sections of patients who died after prefrontal leukotomy likewise indicate a frontothalamic connection, thus establishing a link between the dorsomedial thalamic nuclei and the frontal cortex (Meyer, 1949). According to Meyer, if there had been any lesion of the white matter, then it was possible to observe terminal degeneration in the dorsomedial, ventrolateral thalamic nuclei, mammillary body, Forel's field, globus pallidus, nucleus ruber, and subthalamic nucleus. Meyer further established that the cortical projections in these fields ended in the rostral portion of area 6 and toward the disgranulated portion of area 8, while area 6 sends cortifugal fibers to the thalamic nucleus, ventralis anterior, ventralis lateralis, and recticular nucleus, and from areas 8 and 9 degenerated fibers were likewise found right down to the reticular nucleus, nucleus ventralis, and anterior portion of the ventrolateral group of the thalamic nucleus (Hirawassa Kato quoted by Meyer).

At the same time it was histologically established that there was a connection between the anterior cingulate gyrus and the thalamus. Following bilateral gyrectomy in monkeys there was degeneration of the fibers right down to the nucleus thalamic anterior ventralis and nucleus thalamic anterior medialis (Pribram, Fulton, 1954). These histopathologic findings contributed greatly to the knowledge of the associated paths between the thalamus and the frontal centers.

It is also known that the frontal centers, apart from the corticopetal projections in the thalamus and hypothalamus, are connected with corticofugal projections dividing into corticostriate, corticothalamic, and corticohypothalamic projections.

This establishes the connection of the frontal corticovegetative centers with the

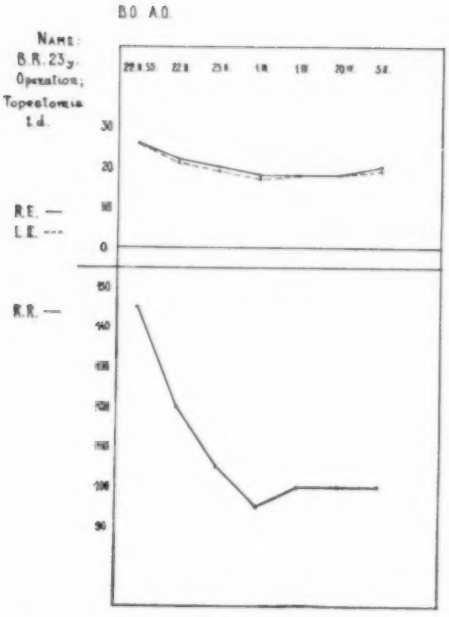

Fig. 2 (Čavka). Diagram showing intraocular and blood pressures in one case after topectomy in right frontal brain.

subcorticohypothalamic vegetative centers which, in turn, by means of the hypothalamic nuclei, nucleus supraopticus, and nucleus paraventricularis, are connected with the eye through the radix dorsalis hypothalamica discovered by Frey (1941). The latter structure starts from the chiasm together with the fasciculus opticus and runs as far as the retina where it becomes linked with the neurosecretorial cells of the retina. This was established in 1955 by Becher and perhaps earlier, in 1946, by Mawas.

After this short anatomic and physiologic introduction, which seemed essential to the present report, I should now like to review my own work on ophthalmoneurologic symptoms and their localization in the corticofrontal centers.

I. Symptoms after operation

Attention has been directed in my studies to the appearance of ophthalmoneurologic symptoms and to the problem of frontocortical regulation of the intraocular pressure. In continuing this work the occurrence of such symptoms in psychopathic patients who had had an operation performed in the frontal portion of the brain was investigated.

As further background for discussion of the ophthalmoneurologic observations, whether motor or neurovegetative, in operated cases, a further review of the symptoms seen is presented. In psychopathic patients three operative methods were used: transorbital leukotomy (after Fiamberti and Čavka), transfrontal leukotomy (Moniz), and topectomy (Pool).

Transorbital leukotomy was performed in 37 cases, in 32 cases bilaterally and in five cases unilaterally. Bilateral transfrontal leukotomy was done in 32 cases; in three of these it was combined with transorbital leukotomy, that is, on one side transfrontal leukotomy, was performed and on the other

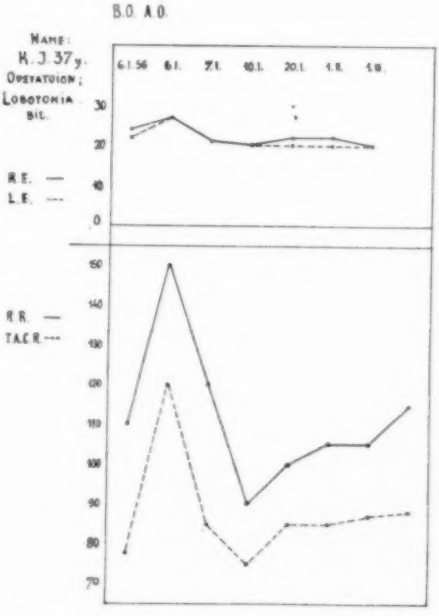

Fig. 3 (Čavka). Diagram showing intraocular and blood pressures in one case after bilateral transfrontal lobotomy.

side (in the same patient) transorbital leukotomy. Unilateral gyrectomy was performed in nine cases. Of these, seven cases were operated on the right side of the brain, and two on the left. In all, surgery was performed on 78 patients.

In the 37 cases in which transorbital leukotomy was performed, the following changes affected the pupils of the eye:

1. *Pupils.* In 30 cases anisocoria was observed, with ipsilateral mydriasis; while in seven cases there was contralateral mydriasis. In one case, for one hour after the operation, there was binocular miosis but later this case also showed ipsilateral mydriasis. In 30 cases the dilatation of the pupil lasted for seven to 15 days after leukotomy and, after this time, only seven cases showed slight visible signs of anisocoria for another five weeks.

2. *Deviated conjugation* of the eyes was intermittently visible for three to four hours after leukotomy; later it always disappeared. Care was taken to differentiate these symptoms from the effects of the narcotics used (pentothal, chemital). In 31 cases deviated conjugation was observed, while in six cases there was none. Of this number 22 cases showed homolateral and five contralateral conjugation; in four cases the deviated conjugation was contralateral and upward.

Fig. 4 (Čavka). Pneumoencephalogram (anteroposterior). Case V. B., aged 53 years (1954), with glaucoma simplex, O.U. The lateral ventricles were enlarged.

Fig. 5 (Čavka). Pneumoencephalogram (posteroanterior) of same case as in Figure 4, showing the enlarged lateral ventricles.

3. *A convergent position of the eyes* was observed as a momentary symptom shortly after leukotomy—in five cases in both eyes. In 14 cases it was possible to observe a transitory horizontal divergence with a varying angle of divergence of 10 to 20 degrees. Vertical divergence was observed only periodically for a few minutes in five cases after leukotomy.

4. *Saccadic movements of the eye* likewise occurred a few minutes after leukotomy, in both eyes in six cases; horizontal nystagmus with larger contralateral amplitudes in four cases; in two cases, blepharospasm.

After transfrontal leukotomy in 32 cases, the following symptoms were observed:

1. *Anisocoria* with homolateral mydriasis in 25 cases, and contralateral mydriasis in six cases. In one case there was miosis of the pupil which lasted for four days; the pupil then returned to its normal size.

2. *Homolateral conjugated deviation* was observed in 23 cases, in seven contralaterally, and in two downward.

3. *Binocular convergence* of the eyes was observed in seven cases, three of which were unilateral and homolateral. Divergence was

Fig. 6 (Čavka). Dextrolateral pneumoencephalogram of same case as in Figures 4 and 5, showing enlargement of the anterior cornu of the lateral ventricles.

visible in 15 cases, four of which were monocular and ipsilateral. Vertical divergence occurred in seven cases.

4. *Saccadic movements* of the eye occurred a few minutes after the operation in both eyes, alternating in five cases and horizontal nystagmus, more marked contralaterally, in four cases. There was blepharospasm for two to five hours after the operation in five cases.

All cases of prefrontal gyrectomy showed anisocoria with mydriasis of the pupil which was homolateral in five cases and contralateral in four.

Conjugated deviation of the eyes was established in seven cases, three ipsilateral and four contralateral and upward. There was horizontal divergence of the eyes in five cases, vertical divergence in one case, and blepharospasm in two.

In lesions of the frontal portion of the brain in which ophthalmoneurologic symptoms are recorded, no analysis can be complete without consideration of operative lesions in certain areas of the frontal lobe. Experimental studies offer an opportunity for more exact topographic and anatomic observations. In clinical studies exact observations may be made in cases with open operative fields (osteoplastic craniotomy), and not in those with closed and invisible operative fields, as in prefrontal leukotomy. In orbital leukotomy, the leukotome passes through orbital areas 11 to 13, and further toward the front through areas 9 and 8; it may also pass through area 24, involving the ventral rim of this area. A similar but not identical lesion has been produced by transfrontal leukotomy. In gyrectomy, decortication of areas 8 and 9 has been carried out, as well as partial decortication of the rostral portion of area 10.

Observations in operative lesions of the prefrontal areas of the brain made it possible to establish the following:

1. *Changes in the pupils* appeared in all operated cases. Anisocoria with an ipsilaterally wider pupil was visible in 60 cases, almost 80 percent.

2. *Homolateral deviated conjugation* of the eyes was established in 48 cases, while it was contralateral to the lesion in 20 cases. In 10 cases it did not appear at all. Consequently deviated conjugation of the eyes was established in 87 percent of the cases, with a much

Fig. 7 (Čavka). Pneumoencephalogram (anteroposterior) in Case E. A., aged 34 years (1954), showing slight enlargement of the lateral ventricles. The patient had glaucoma simplex, O.U.

larger number with deviation of the eyes homolateral to the operative lesion.

3. *Horizontal divergence* was visible in 34 cases, 43 percent; while convergence was recorded in 13 operated cases.

From the symptoms mentioned one may conclude that the main ophthalmoneurologic symptoms produced by operative lesions of the prefrontal area are anisocoria of the pupils, conjugated deviation of the eyes, and horizontal divergence of the eyes. On the other hand convergence of the eyes, vertical divergence and saccadic movements, as well as nystagmus, may be less frequent symptoms.

In comparing these findings in 78 patients who underwent operations in the prefrontal portion of the brain with the clinical and experimental observations of Fulton, Hess, Akert, Penfield, Ward, Mettler, and others, the convergent and divergent horizontal positions of the eye, vertical divergent movements after Hartwig-Magendi, horizontal saccadic movements, and horizontal monocular and binocular nystagmus may be considered as additional observations.

Apart from the anisocoria which, in some

Fig. 8 (Čavka). Case E. A., aged 34 years (1954), showing in the posteroanterior position enlargement of the lateral ventricles. The patient had glaucoma simplex, O.U.

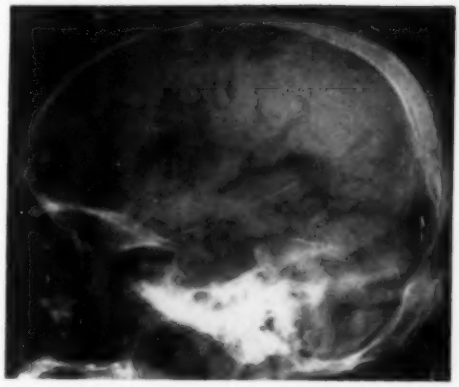

Fig. 9 (Čavka). Case I. N., aged 52 years (1953), with glaucoma simplex, O.U., showing (right lateral position) an enlarged subarachnoid pattern in the frontal lobes.

cases, lasted more than a month and, in other cases, appeared seven to 14 days after operation, all the other symptoms were of short duration—three to five hours after operation. As has already been mentioned, the temporary character of these symptoms was recorded by Hess who explained them by the electric stimulation of the frontal cortex. He maintained that they were unstable and temporary and that their significance lay in the analysis of the cortical functions of the concomitant regulatory mechanism and not as subcortical hypothalamic centers which show much more stable symptoms after electric stimulation.

II. Changes in intraocular pressure

During the present studies on the ophthalmoneurologic symptoms in patients on whom leukotomy had been performed, changes in intraocular pressure and in general blood pressure were noted.

It must be emphasized that none of the eyes of the operated psychopaths showed increased intraocular pressure prior to the operation. For several days (five to six) the pressure was checked carefully and was found to be normal in all these patients. My intention was to establish whether or not, after the operation, there were any changes

Fig. 10 (Čavka). Case F. J., aged 32 years (1956), with pseudoglaucoma, O.U., showing (anteroposterior position) enlargement of the lateral ventricles.

in intraocular pressure, so tonometry and blood pressure measurements were continued for some time after the operation. It was observed in a number of patients that both the intraocular and blood pressure rose and fell during the period following the brain operation. This was especially evident during the first days or weeks after the operation.

In the first group of 10 patients who had leukotomy during 1952, it was observed that, during the postoperative period, there were slight changes in intraocular pressure; however, these changes were within the normal limits (Arch. Ophtal., 1953, p. 465). These measurements were not, however, carried out systematically and completely; therefore, the data obtained were not exact. For this reason, systematic examinations were made of the intraocular and blood pressure and, in certain cases, of the central retinal artery pressure as well.

In all, 10 cases were studied. In eight of these prefrontal leukotomy was performed and in two cases (Cases 2 and 7) it was combined with transorbital leukotomy. In another six cases prefrontal topectomy was done on the right side only. The postoperative measurements of intraocular and blood pressure were carried out over a period of three months. The results are tabulated in Table 1.

In the first 10 cases in which prefrontal leukotomy was performed, the results were:

1. In five cases there was a rise in intraocular pressure of 4.0 to 8.0 mm. Hg; in the 10th case, there was an almost pathologic rise in intraocular pressure amounting to 30 mm. Hg in the right eye, and 27 mm. Hg in the left eye.

2. In four cases there was a decrease of from 3.0 to 7.0 mm. Hg in intraocular pressure. In one case the changes were negligible (Case 4).

3. In six cases in which topectomy had been performed on the right prefrontal brain, there was a rise in intraocular pressure in three cases, and a fall in three. The fall varied between 4.0 and 8.0 mm. Hg, and the rise from 4.0 to 12 mm. In Case 14 the intraocular pressure was at times 30 mm. Hg in the right eye and 34 mm. Hg in the left.

4. Measurement of the blood pressure in connection with the intraocular pressure sometimes gave doubts that the fall might be synchronized as shown by the cases in which both pressures were measured (3, 5, 9, 12, 13, 14, and 16). However, from the results obtained in Cases 8, 10, and 11, one might suppose there was a synchronized rise in both pressures. Pressure measurements of the central retinal artery in two cases of prefrontal leukotomy and in three cases of topectomy showed a synchronous fall and

Fig. 11 (Čavka). The brain of a cat (B.o.) Bulbus olfactorius. (O) Orbital areas of the brain. (C) Cerebellum.

TABLE 1

RELATION BETWEEN INTRAOCULAR PRESSURE AND BLOOD PRESSURE AFTER BRAIN OPERATIONS

Case No.	Date of Operation	Date of Measuring	Intraocular Pressure (mm. Hg)				Blood Pressure (mm. Hg)		Remarks
			Before		After				
			R.E.	L.E.	R.E.	L.E.	Before	After	
1	12/24/53	12/24 12/25 4/10/54	20	20	 21 20	 27 22	100/80	 100/70 100/75	Lobotomy prefrontal Leukotomy
2	1/15/54	1/13 1/14 4/10	20	22	 20 21	 27 21	140/100	 115/80 110/80	Labotomy prefrontal Leukotomy transorbital
3	10/15/53	10/15 10/16 1/10/54	22	23	 ↓18 18	 ↓17 18	160/100	 100/60↓ 100/60	Labotomy prefrontal Synchronous
4	2/16/53	2/16 2/17 4/25	21	22	 23 19	 23 18	130/80	 110/70 110/70	Lobotomy prefrontal Synchronous
5	1/12/53	1/12 1/13 3/12	22	24	 18 18	 17 18	100/60	 90/65 90/65	Lobotomy prefrontal
6	12/23/53	12/23 12/24 3/10/54	21	22	 23 17	 23 16	120/80	 108/80 100/65	Lobotomy prefrontal
7	2/16/54	2/16 2/18 4/24	23	21	 22 18	 22 17	130/90	 120/80 120/70	Labotomy prefrontal Leukotomy transorbital
8	2/16/54	2/16/54 2/17 5/20	20	18	 23 25	 23 26	140/90	 120/80 140/90	Lobotomy prefrontal
9	1/12/54	1/12 1/13 4/10	20	22	 20 16↓	 27 18↓	115/80	 120/90 105/75↓	Lobotomy prefrontal Synchronous
10	8/13/54	8/13 8/14 9/25	23	23	 30↑ 21	 27↑ 19	115/70	 125/70↑ 105/60	Labotomy prefrontal Synchronous
11	2/16/54	2/16 2/20 4/25	18	17	 23 23	 23 23	115/90	 121/81 120/80	Topectomy prefrontal
12	12/12/53	12/12 12/20 6/10/54	19	19	 15↓ 18	 18 18	120/80	 100/70↓ 100/68	Topectomy prefrontal Synchronous
13	2/22/55	2/22 2/24 10/5	26	26	 18↓ 18	 17↓ 18	145/100	 105/70↓ 100/65	Topectomy prefrontal Synchronous
14	11/22/55	2/22 2/24 3/15/56	22	22	 30 22↓	 34 20↓	165/110	 165/115 125/80↓	Topectomy prefrontal Synchronous
15	11/23/55	12/23 12/25 5/20/56	25	25	 23 18	 23 18	110/70	 110/70 98/70	Topectomy prefrontal
16	1/6/56	1/16 1/17 2/10	23	22	 32 22↓	 26 21↓	160/120	 101/70 95/65↓	Topectomy prefrontal Synchronous

↑ ↓ Synchronous rise or fall of intraocular and blood pressure.

rise in blood and intraocular pressure.

5. Follow-up measurements of both blood and intraocular pressure in these operated cases, carried out within six months to two years, recorded no unstableness of either pressure. Both blood and intraocular pressure readings were identical to those taken before operation.

III. GLAUCOMA PATIENTS

In addition to tests on patients who had had frontal brain surgery, further studies were made on patients suffering from primary glaucoma. Besides routine clinical and laboratory tests, examinations were made of postencephalitic conditions, the endocrine system, and the cerebrospinal fluid, and

TABLE 2

STUDIES ON PATIENTS SUFFERING FROM GLAUCOMA AND POSTENCEPHALITIS CONDITIONS

Age	Disease	Number of Cases	Corticosteroids Basal Metabolism	Symptoms of Encephalitis	Cerebrospinal Fluid	Audiogram	Pneumoencephalography		
							Dilatation of Subarachnoid Pattern	Dilatation of Chiasmal and Interpeduncular Cisterns	Dilatation of Ventricles
from 22 to 58 years	Glaucoma congestive	7	C.S. 17, +1 c. B.M. from −4% to +10%	+2 c.	Pandy + in 6 c. N.A. +1 c.	+4 c.	Frontal +4 c. Frontoparietal +3 c.	Chiasmal +2 c. Interpeduncular +2 c.	+4c.
from 24 to 59 y	Glaucoma simplex	12	C.S. 17, +3 c. B.M. from −6% to +9%	+5 c.	Pandy + in 4 c. N.A. + in 3 c.	+5 c.	Frontal +6 c. Frontoparietal + 4 c.	Chiasmal +6 c.	+6 c.
from 4 to 28 y	Hydrophthalmus	8	C.S. +1 c. B.M. from +1% to +4%	+1 c.	Pandy + in 5 c. N.A. + in 2 c.	+1 c.	Frontal +3 c. Parietal +1 c.	Chiasmal +1 c. Interpeduncular +2 c.	+4 c.
20 and 21	Sturge-Weber syndrome	2	C.S. +1 c. B.M. +2% +3%		Pandy + in 1 c.		Frontoparietal to occipital +1 c.	Interpeduncular +1 c.	+2 c.
25	Marfan's syndrome	1	M.S. +2%		Pandy + N.A. +		Frontal +1 c.	Chiasmal	+
27	Glaucoma without hypertension	1	B.M. +4%		Pandy + N.A. +		Frontal +1 c.		+
	Total	31	B.M. ±31 c. C.S. +6 c.	+8 c.	P. 18 N.A. 7	+1 c.	+24 c.	+15 c.	+18 c.

pneumoencephalography and audiography were done. These tests were made in cases of primary glaucoma which differed clinically, in cases of hydrophthalmos, in Sturge-Weber and Marfan's syndrome with glaucoma, and in one case of glaucoma without intraocular hypertension (Table 2).

Certain findings in Table 2 were positive and it is, therefore, necessary to emphasize the pneumoencephalographic findings. It was established in 24 cases of glaucoma that the subarachnoid pattern was pathologically enlarged in the frontoparietal area of the brain. This would seem to indicate atrophy of the frontal or parietal cerebral cortex. Distention of the lateral ventricles indicated hydrocephalus in these cases of glaucoma, a finding which might be explained by a more or less developed atrophy of the brain substance. Possible atrophy in the region of the diencephalon or mesencephalon could explain distention of the basal cisterns.

Only 15 cases were examined for postencephalitic conditions, and in eight of these the findings were positive, showing symptoms of a former masked encephalitis. The symptoms included radial deviation of the hand from the medial line, pronation of the hands when hanging, the superciliary abductory symptoms, and narrowing of the rima palpebrarum.

In 10 young patients in whom there was no presbyacusia, the audiogram was positive, revealing pathologic lesions of the acoustic nerve. Tests of the basal metabolism in order to ascertain the existence of glaucoma thyroidea and tests of the function of the hypophysis revealed nothing which might be taken as an indication of endocrine dysfunction in glaucoma patients. However, positive Nonne-Appelt and Pandy reactions were observed in 25 patients suffering from glaucoma. This might well be explained by pathologic residua in the cerebrospinal fluid after encephalitis.

These changes in the brain cannot be dismissed as accidental; on the contrary, they speak in favor of some pathologic substrate connected with glaucoma.

IV. ANIMAL EXPERIMENTS

In those test animals in which the intervention was made in the frontorbital portion

of the brain, the major investigation concerned the change in intraocular pressure connected with the operative brain lesions. Before the animals were operated upon intraocular pressure was checked twice a day for three consecutive days in order to obtain a clear picture of the average values of the intraocular pressure in the animals before operation. Since we did not have the necessary equipment, it was not possible to take the blood pressure.

Operating technique

In cats, ether anesthesia was used; in dogs 2.5 to 5.0-percent Chemital. Cats were sensitive to anesthesia with Pentothal or Chemital and two cats died during anesthesia with these substances. The cats tolerated ether anesthesia well, as dogs did Chemital. The duration of anesthesia was made to last only during osteoplastic craniotomy which was performed on all the animals. We consider this method the most suitable for experimental study of operative lesions on the brain, since the operative field thus obtained is wide and gives a good view; further anesthesia is almost nonexistent once craniotomy has been performed. Consequently it was possible to carry out electrodiathermic lesions on the orbital brain of these animals while they were completely conscious. The reactions on the intraocular pressure were closely observed, as were other neurologic symptoms. By applying this method it was possible to eliminate almost completely any anesthesia accidents.

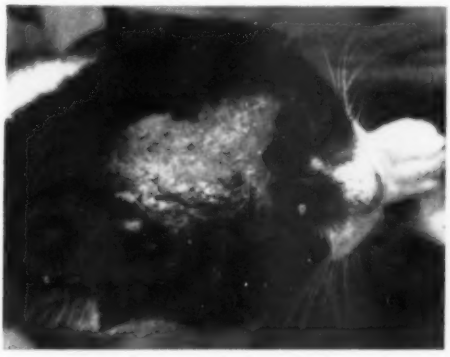

Fig. 12 (Čavka). Cat 1 after osteoplastic craniotomy on the left side.

Fig. 13 (Čavka). Dog after osteoplastic craniotomy on the left side.

The brain lesions were made with a diathermic needle (gauge 0.5 mm.) and with a current of 20 ma. This procedure constituted only one part of the research in which electrodiathermic lesions were inflicted on the orbitofrontal portions of the brain and was used in performing cranioplastic operations in the following animals:

Experimental animals

Case 1. Cat, black and white, weight 2.7 kg. Intraocular pressure, checked twice a day for three days, was found to be 20 mm. Hg in the right eye and 18 mm. Hg in the left.

The cat was anesthetized with ether, and on September 29, 1956, an osteoplastic craniotomy was performed on the left side of the head. After the bone had been trephined and removed and the dura opened, the internal table of the frontal bone had to be removed in order to give access to the orbitofrontal portion of the brain and to obtain a clear view of the operative field.

The electrodiathermic decortication of the left orbitofrontal portion of the brain was carried out in an elliptical form measuring 7.0 by 10 mm. In the course of the electrodiathermic cauterization, it was possible to observe anisocoria of the pupils with a contralaterally wider pupil (4.0 by 2.0 mm.). After decortication, horizontal divergence of the eyes was observed, lasting four days after operation. Anisocoria was visible for one and a half months after the operation, the contralateral pupil being wider. During operation the electrodiathermic lesions of the brain caused visible contralateral clonic movements of the head, the anterior part

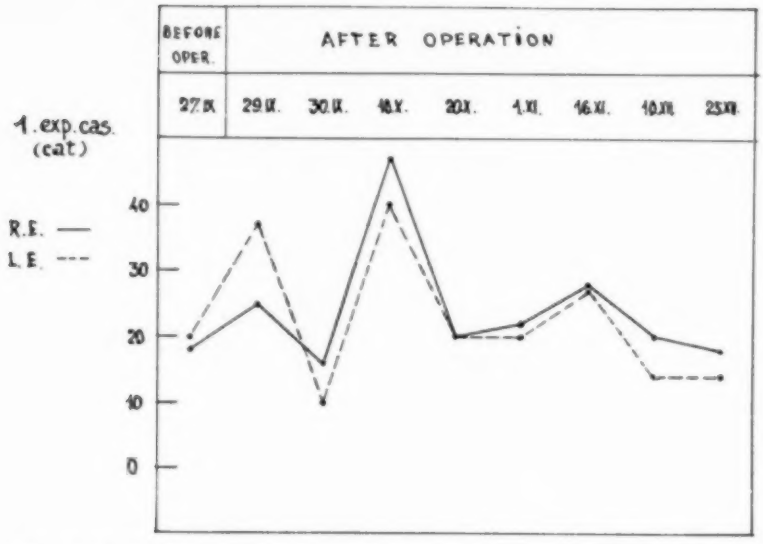

Fig. 14 (Čavka). Diagram of the intraocular pressure in experimental Case 1 (cat).

of the body, and the anterior extremities.

Immediately after operation, the intraocular pressure was: R.E., 30 mm. Hg, L.E., 37 mm. Hg. Eight hours later, it was: R.E., 18.0 mm. Hg, L.E., 13 mm. Hg. At 17 hours: R.E., 18 mm. Hg, L.E., 10 mm. Hg.

During the following seven days, the intraocular pressure varied from: R.E., 20 to 23 mm. Hg; L.E., 11.5 to 16 mm. Hg.

Diurnal variations in the intraocular pressure followed this pattern: At 8:00 A.M. on October 10th, R.E., 47 mm. Hg, L.E., 40 mm. Hg; at 5:00 P.M., R.E., 30 mm. Hg, L.E., 26.5 mm. Hg. At the same hours on October 20th, R.E., 24 mm. Hg, L.E., 20 mm. Hg; R.E., 32 mm. Hg, L.E., 16 mm. Hg. On November 1st, the readings were: R.E., 21.5 mm. Hg, L.E., 18 mm. Hg; R.E., 23 mm. Hg, L.E., 16 mm. Hg. On November 16th: RE., 26.5 mm. Hg, L.E., 26.5 mm. Hg; R.E., 30 mm. Hg, L.E., 16 mm. Hg.

Case 2. Cat, white and yellow, weight 3.1 kg. The intraocular pressure prior to operation on October 27, 1956, was: R.E., 26.5 mm. Hg, L.E., 23 to 26.5 mm. Hg. On October 28, 1956, a left osteoplastic craniotomy was performed with decortication by electrodiathermy. Anesthesia was with five-percent Chemital. Twelve hours after operation, intraocular pressure was: R.E., 40 mm. Hg, L.E., 30 mm. Hg. Eight hours later, it measured: R.E., 24 mm. Hg, L.E., 25.5 mm. Hg.

Diurnal variations durng the next two days showed: October 29th at 8:00 A.M., R.E., 40 mm. Hg, L.E., 30 mm. Hg; at 5:00 P.M., R.E., 35 mm. Hg, L.E., 35 mm. Hg.

After the operation it was possible to observe visible deviation of the eyes to the right and anisocoria with an ipsilaterally wider pupil. On October 31, the animal died.

Case 3. Cat, black and white, weight 2.9 kg. Prior to operation the intraocular pressure was: R.E., 23 mm. Hg, L.E., 23 to 26.5 mm. Hg. On November 15, a craniotomy and decortication were performed under five-percent Chemital anesthesia. After operation, the intraocular pressure was: R.E., 35 mm. Hg, L.E., 35 mm. Hg. Five hours later it was 16 mm. Hg, O.U. Anisocoria with ipsilateral mydriasis was present. At 8:00 A.M. the next day pressure readings were: O.U., 16 mm. Hg, at 5:00 P.M., R.E., 13.5 mm. Hg, L.E., 16 mm. Hg. On November 17th, the animal died.

Case 4. Cat, ginger, weight 3.2 kg. Intraocular pressure prior to operation was: R.E., 20 mm. Hg, L.E., 23 mm. Hg. An osteoplastic craniotomy with decortication under ether anesthesia was performed on November 6th.

After the operation the distance between the lids on the right side became narrower. There were contractions of the pupil with miosis and change to mydriasis several times in the course of 10 minutes. Finally the left pupil dilated (7.0 to 8.5 mm.). The right eye deviated downward and then there was deviation of the eyes to the right (contralateral to the lesion). Clonic twitching of the head, right lip, whiskers, anterior part of the body to the opposite side were visible when decortication was being carried out and, at that time, one could also see contralateral deviation of the eyes. Shortly after operation the intraocular pressure was: R.E., 26.5 mm. Hg, L.E., 35 mm. Hg; six hours later: R.E., 23 mm. Hg, L.E., 26.5 mm. Hg. The next day

the readings were: R.E., 23 mm. Hg, L.E., 26.5 mm. Hg; R.E., 24 mm. Hg, L.E., 24 mm. Hg.

During the next six weeks intraocular pressure in both eyes showed normal values. There was slight anisocoria all the time, the pupil on the same side as the operation being wider.

Case 5. Dog, yellowish, weight 9.4 kg. Before operation the intraocular pressure was: O.U., 20 mm. Hg. On October 9th, an osteoplastic craniotomy with decortication by electrodiathermy was performed. After operation, the pressure readings were: R.E., 40 mm. Hg, L.E., 35 mm. Hg.

Variations in the 8:00 A.M. and 5:00 P.M. pressure readings were: October 10th, R.E., 40 mm. Hg, L.E., 35 mm. Hg; R.E., 35 mm. Hg, L.E., 35 mm. Hg. October 11th, R.E., 20 mm. Hg, L.E., 23 mm. Hg. October 30th, R.E., 21.5 mm. Hg, L.E., 21.5 mm. Hg. November 15th, R.E., 21.5 mm. Hg, L.E., 21.5 mm. Hg; R.E., 40 mm. Hg; L.E., 47 mm. Hg. November 23rd, O.U., 47 mm. Hg. November 30th, R.E., 26.5 mm. Hg, L.E., 47 mm. Hg. On December 15th, R.E., 20 mm. Hg, L.E., 25 mm. Hg.

During four weeks there was slight anisocoria with the wider pupil being either right or left.

Case 6. Dog, white and gray, weight 8.5 kg. Prior to operation on October 28, 1956, intraocular pressure was: R.E., 23 to 26.5 mm. Hg; L.E., 23 to 24 mm. Hg. On October 30th an osteoplastic craniotomy with decortication by electro-diathermy was performed. Twelve hours after operation intraocular pressure was: O.U., 40 mm. Hg. Diurnal variations (8:00 A.M. and 5:00 P.M.) were: October 31st, R.E., 26.5 mm. Hg, L.E., 23 mm. Hg; R.E., 26.5 mm. Hg; L.E., 21.5 to 23 mm. Hg. Up until November 10th, the intraocular pressure varied in both eyes from 23 to 26.5 mm. Hg. Then the morning readings were: November 11th, R.E., 35 mm. Hg, L.E., 40 mm. Hg; November 13th, R.E., 40 mm. Hg, L.E., 47 mm. Hg; November 15th, R.E., 35 mm. Hg; L.E., 40 mm. Hg; November 30th, R.E., 30 mm. Hg; L.E., 30 mm. Hg.

During the operation there was chronic twitching of the head on the opposite side. On the left side there was ptosis which lasted for one day after operation. Anisocoria was visible, with an ipsilaterally wider pupil for eight weeks.

Case 7. Dog, black and white, weight 10.4 kg. The intraocular pressure prior to operation was 23 mm. Hg in both eyes. On November 10th, an osteoplastic craniotomy with decortication was performed.

Eleven hours after operation, the pressure readings were: R.E., 16 mm. Hg, L.E., 13.5 mm. Hg. At 18 hours after operation, they were: R.E., 11.5 mm. Hg, L.E., 8.0 mm. Hg. Daily variations (7:00 A.M. and 8:00 P.M.) were: November 11th, R.E., 9.0 mm. Hg, L.E., 11.5 mm. Hg; R.E., 18 mm. Hg, L.E., 7.0 mm. Hg; November 12th, R.E., 16 mm. Hg, L.E., 11.5 mm. Hg; O.U., 13.5; November 15th, R.E., 21.5 mm. Hg, L.E., 23 mm. Hg; O.U., 23 mm. Hg. Beginning November 20th only one reading a day was taken; on this date it was O.U., 30 mm. Hg; November 27th, O.U., 35 mm. Hg; November 29th, R.E., 35 mm. Hg, L.E., 40 mm. Hg; November 30th, O.U., 30 mm. Hg; December 10th, O.U., 30 mm. Hg; December 30th, O.U., 23 mm. Hg.

Anisocoria was present for one month, with ipsilateral dilation of the pupil, predominantly on the right side.

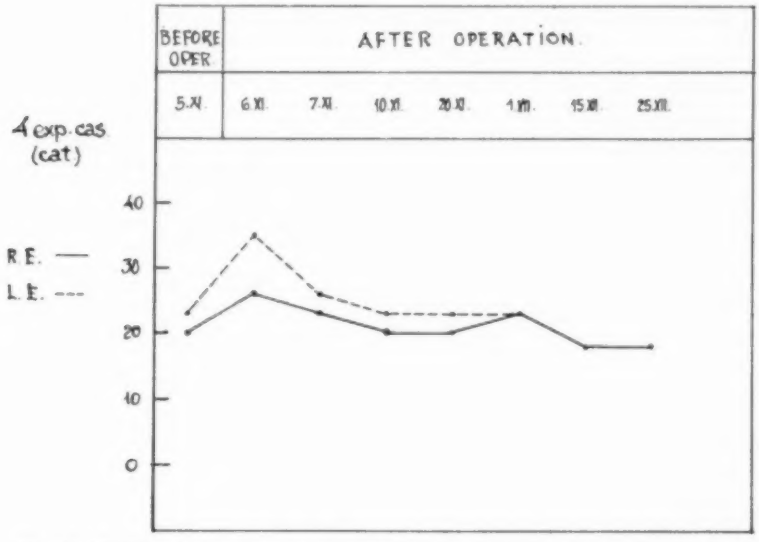

Fig. 15 (Čavka). Diagram of the intraocular pressure in experimental Case 4 (cat).

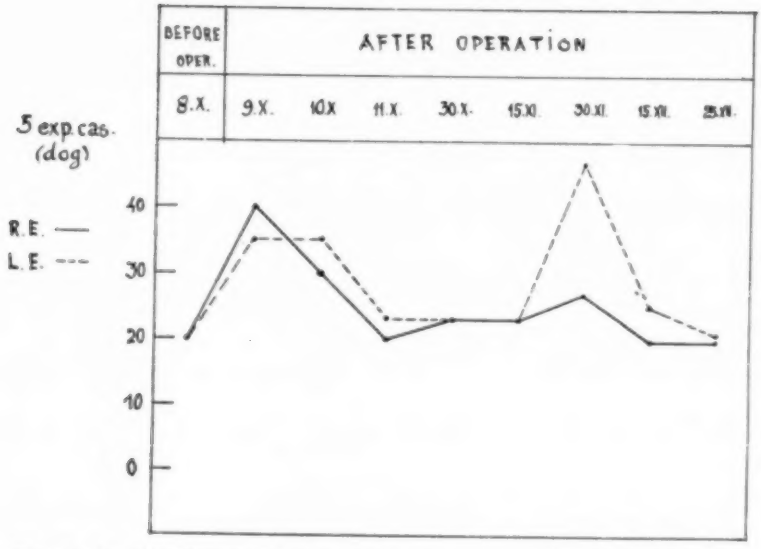

Fig. 16 (Čavka). Diagram of the intraocular pressure in experimental Case 5 (dog).

During the operation, when the brain substance was touched by the diathermic needle, there was always chronic twitching of the head on the opposite side.

Summarizing the observations on the intraocular pressure in animals during operation and after:

1. In Case 1 (cat), immediately after the operation, there was a rise in intraocular pressure, especially in the left eye (ipsilaterally) to 10 mm. Hg. In the course of the 12 days after the operation pressure again rose in both eyes (40 to 47 mm. Hg). Further measurements for one and a half months after operation showed normal values.

2. In Cases 2 and 3, the animals died so that the observations were of short duration. However, in Case 3, there was a visible rise in pressure after operation and the same afternoon a considerable fall in pressure which persisted in both eyes for 48 hours.

In Case 4 there were few visible changes although the cat was checked for six weeks after the operation.

3. In Case 5 there was a rise in intraocular pressure, especially in the left eye, which lasted for as long as 50 days after the operation.

In Case 6, there was also a rise in intraocular pressure in the postoperative period which lasted one month after operation; 25 to 35 mm. Hg for the right eye and about 20 to 47 for the left.

Case 7, a dog, showed, immediately after operation, a fall in intraocular pressure and hypotonia which was especially pronounced two days after operation. The minimum intraocular pressure in the right eye was 9.0 mm. Hg, and in the left eye, 7.0 mm. Hg. During the following three weeks, there was a rise in intraocular pressure in both eyes: R.E., to 35 mm. Hg; L.E., to 40 mm. Hg.

The ophthalmoneurologic symptoms in these animals took the form of anisocoria of the pupils, deviated conjugation of the eyes, lateral divergence of the eyes, ptosis of the lids, and clonic twitching of the muscles of the face, anterior part of the body, and front extremities.

In five cases there was anisocoria with an ipsilaterally wider pupil and, in one case, the pupil was wider on the opposite side. In

one case there was alternating dilation of the pupils. Conjugated deviation existed in two cases on the opposite side, while there was clonic twitching of the head and anterior part of the body on the opposite side in four cases. There was ptosis in only one case and that on the same side.

Regarding the observations of intraocular pressure in these animals, it is clearly established from these findings that there were changes in intraocular pressure in animals after operative lesions of the brain. These changes were most probably connected with the lesions of the frontorbital portion of the brain. In five animals (Cases 1, 3, 5, 6 and 7), there were increases and decreases in the intraocular pressure. In Cases 2, 5, 6, and 7 these changes were considerable.

Discussion

Although the diencephalic center for regulating intraocular pressure represents a unique subcortical station, we know that the hypothalamic neurovegetative centers are connected with the frontocortical centers through relay stations of the thalamus (Magitot, Thiel, Jaensch, Sallmann, Lowenstein, Greaves, Schmerl, Steinberg, and others). The present study was directed principally toward discovering relations and connections between the hypothalamic and frontocortical centers and toward establishing objective signs which would point to the existence of one central frontocortical center for the regulation of the intraocular pressure.

Research on psychopaths on whom prefrontal leukotomy or lobectomy was performed yielded certain positive results concerning central frontal regulation, not only of the intraocular pressure but also of general arterial pressure. Although the elevations and decreases of intraocular pressure registered after operation on the brain were not great, nevertheless, in certain cases, they rose as much as 12 mm. Hg and fell as low as 8.0 mm. Hg. This variation was not established in the patients before operation.

In the preoperative stage the fluctuations in intraocular pressure in these patients varied between 2.0 and 4.0 mm. After operation, marked fluctuations in the intraocular pressure continued for as long as two months. After this period, in all cases, the intraocular pressure returned to the level established

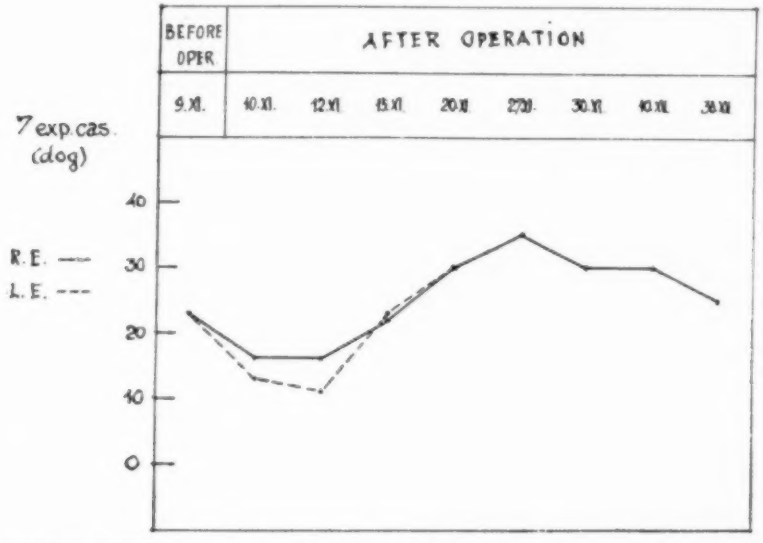

Fig. 17 (Čavka). Diagram of the combined intraocular pressure in experimental Case 7 (dog).

before operation. A synchronism between the intraocular pressure, the general arterial pressure, and the central retinal artery pressure could be established in about 50 percent of the operated cases.

According to these findings concerning synchronization in the oscillations of intraocular and blood pressures, there is a possibility that there are associated paths between the center for intraocular pressures and that for blood pressure. It might be that these centers are close to each other in the prefrontal cortical and orbital areas. This association between these two centers in the prefrontal and orbital areas has an analogy in the hypothalamus where von Sallmann and Lowenstein established the same association for intraocular pressure and blood pressure. According to these two authors, the changes in intraocular pressure coincided with changes in blood pressure in electrodiathermic stimulation of the hypothalamus.

In addition to these studies on patients operated in the frontal portion of the brain, the clinical-laboratory analysis of patients suffering from glaucoma offered certain results. The pneumoencephalographic findings, in 23 patients suffering from glaucoma among the 30 cases examined, showed pathologic changes of the subarachnoid pattern in the frontal and frontoparietal portion of the brain. In 17 patients with glaucoma, the ventricular system was distended and there was internal hydrocephalus to a varying degree. These pneumoencephalographic findings indicated a cortical atrophy, expressed in the frontal and frontoparietal portion of the brain. In 15 patients suffering from glaucoma, there was distention of the basal cisterns, and this, too, may indicate atrophy of the brain appearing in the area of the diencephalon.

In one case of glaucoma without hypertension in either eye (pseudoglaucoma), there were pneumoencephalographic changes showing a distention of the subarachnoid pattern in the frontal portion of the brain, as well as visible distention of the ventricular system. In 1946 Sjøgren made similar observations in four cases of pseudoglaucoma. In his cases pneumoencephalography revealed distention of the lateral ventricles. This author stated that this was caused by cerebral atrophy linked with a lacunary atrophy of the nerve in pseudoglaucoma. According to these findings it appears that the cerebral atrophic changes in cases of pseudoglaucoma are similar to the brain changes in cases of glaucoma. Therefore the question arises whether the atrophic changes in the brain are due to a previous encephalitic process or whether they are essential in character. According to the present findings, it would seem that a previous inflammatory process originated these changes. The positive albumin-globulin reactions (Pandy) in 18 cases of glaucoma and Nonne-Appelt in seven others seem to substantiate this theory. Further symptoms of a residual masked encephalitis were established in eight cases of glaucoma (Vujić) out of only 50 percent studied with this condition in mind. These findings seem to justify the assumption that, in a number of cases of glaucoma, an inflammatory etiology must be taken into consideration when there is an associated atrophy of the brain substance. However, other inflammatory factors or chronic intoxications may also be the cause of atrophic areas in certain parts of the brain. Undoubtedly any major arteriosclerosis of the brain vessels has an important role in brain atrophy in glaucoma, especially if it occurs in those areas where the centers for regulating intraocular pressure are located.

The experimental findings in the test animals in which lesions were inflicted on the frontorbital portions of the brain indicate the existence of a frontorbital center for intraocular pressure.

In reviewing all the findings and results of the research in psychopaths, the findings in cases of glaucoma, and the results obtained in test animals, the opinion may be

emphasized that, in the prefrontal and orbital areas of the brain, there are regulatory centers for intraocular pressure and that there are also associated paths for intraocular pressure and blood pressure. This clearly shows the importance of the frontorbital cerebral centers in association with the hypothalamic centers for the regulation of intraocular pressure and probably in the etiology of primary glaucoma. Accordingly, the hypothesis that glaucoma is the consequence of a pathologic alteration of the neurovegetative centers which develops in varying degrees in different areas may be advanced. Due to the formation of such pathologic foci in the central neurovegetative centers, the central regulation for intraocular pressure and for blood pressure appears to lose its normal equilibrium. As a consequence the central tonus of the elevators may exceed the tonus of the depressors or conversely. Since this central dysfunction is reflected in the neurovascular-secretory elements of the eye, pathologic increases in intraocular pressure may be created.

Summary

Anisocoria, conjugate deviation, abnormal binocular convergence and divergence, saccadic movements, horizontal nystagmus, and blepharospasm were added by the present study to previously reported neuro-ophthalmologic symptoms in psychopathic patients undergoing operation on the frontal portion of the brain.

Intraocular pressure in the postoperative stage showed, in certain cases, that both increases and decreases were synchronous with the behavior of the blood pressure and the central retinal artery pressure.

After decortication in dogs and cats, there was considerable oscillation in the intraocular pressure; sometimes there was a definite intraocular hypotonia.

Clinical and experimental research studies seem to indicate that cortical centers for the control of intraocular pressure are situated in the prefrontal and orbital areas of the brain where there probably are associated paths for controlling both intraocular and blood pressures.

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Ophthalmic Miniature

There is no one present who has not been pained over and over again by having to treat cases of glaucoma which were brought to him too late. In spite of all that has been done by specialists, and in spite of the fame which iridectomy cures have obtained, it is still the fact that a large proportion of cases of acute glaucoma are unrecognized during the first fortnight by those under whose observation the patients come. Practitioners of the most scrupulous care, of wide general information, and the most conscientious regard for their patient's good, are yet very commonly misled by the acute congestion and severe constitutional symptoms which often attend the early stages of this disease.

It was my fortune, some years ago, to operate upon three cases of this kind in one week, in all of which the proper time for interference had been allowed to pass by, on account of the patients' severe general illness.

In one instance I became acquainted with the facts of a case in which a benevolent country surgeon, aided by two or three friends, was himself maintaining a lady who had lost her sight, and consequently her occupation, from double acute glaucoma. He had himself attended her from the beginning, and when I gently hinted at the possibility—to me, a practical certainty—that iridectomy at the proper time would have saved the lady's sight for the rest of her life, he promptly replied "that the eyes were so much inflamed in the first instance, and the patient so ill, that he was quite sure I should never have thought of operating." I said no more, for it would have been cruel to tell him that these were the very symptoms which denoted the necessity for an operation.

Jonathan Hutchinson, "Introductory Address at the Opening Meeting of the Session 1883-4," Tr. Ophth. Soc. U. Kingdom, **4**:10-11, 1884.

NOTES, CASES, INSTRUMENTS

FILARIA LOA*

Report of a case

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Loa loa is classified as a filaria or threadworm and is widely distributed throughout tropical West Africa. This parasite requires an intermediate host, the mangrove fly, for a complete life cycle and the localization of the fly to West Africa keeps the disease indigenous to this section (Manson-Bahr[1]). The adult parasite pursues an erratic course in the subcutaneous tissue and has a predilection for the eyelids and subconjunctival space.[2] Although ophthalmologists in this country are rarely called upon to remove filaria from the eye, it is possible that information about the characteristics of the parasite might prove helpful.

Case report

History. A missionary nurse was seen in the office because she had a "worm in the left eye." She had recently come from a region in West Africa where Loa loa was prevalent. She was referred by a missionary physician who was quite sure that the worm was Loa loa. On two previous occasions she had reported to hospitals in this country about her eye but she states "no one paid any attention to me nor believed me."

The patient made the following statement "I was first bitten by the mangrove fly in the spring or summer of 1948 while living in the northeastern Belgian Congo, 45 miles from the government post of Ango on the Uele River. I did not see the fly at that time but the sting was severe and quite typical, being on the lower leg back of the knee. The area was red, swollen, irritated, and about the size of a half dollar. "During the next two years I was bitten twice more. The first symptoms were swelling and pain of the right hand which occurred at class where considerable writing was required in 1951. Calabar swellings have been noticed from time to time since this date. They follow no set pattern but may arise following unusual activity. They are often quite painful and the skin area is itchy. I have often noticed the progress of migration by swellings. It would be in the hand one day, in the lower arm later, and still later move to the upper arm. Sometimes I am not aware of the migrations. When crossing the top of the head it is quite painful and feels like a bruise or a bump. There is not much swelling when the worm is in the eye region but it can be easily felt crossing the eyeball. The worm often crosses back and forth across the eye at night. When I spank the children, the worm increases its activity. Since 1948, the Loa loa had crossed the eye only five times that I can remember."

The patient stated that she became aware of irritation and movement in the temporal aspect of her left eye shortly after she retired on the night of June 8, 1957. She felt the worm cross the surface of the eyeball several times during the night. The movement of the worm was observed beneath the conjunctiva as she looked in the mirror.

Examination and treatment. The patient was seen in the office at 9:00 A.M. on June 9, 1957. There was a small undulating ridge beneath the hyperemic conjunctiva in the superior temporal quadrant of the left eye. The worm was moving slowly, appeared yellowish white beneath the conjunctiva, but could not be accurately measured due to its serpentine coils.

Prior to making a small incision in the conjunctiva adjacent to the worm two drops of tetracaine were instilled. Following this topical application, no movement could be seen and the worm apparently had moved. Twenty minutes later an undulating movement could be easily detected subcutaneously at the lateral canthus. Following an attempt to incise the skin without anesthetic the worm again suddenly moved. Ten minutes later it was discovered subcutaneously in the lower lid 20 mm. from the last position.

An infiltration block with procaine (two percent) was performed over a large area surrounding the worm. A skin incision adjacent to the worm again provoked his disappearance. By patiently waiting at the incision the worm suddenly appeared waving its anterior segment in the air and was promptly secured and extracted with fine smooth forceps. The worm measured 21 mm. in length. The skin incision was closed with 6-0 black silk. The patient experienced no further worm movements and returned to her missionary post two months later.

Discussion

The parasite, the Loa loa, has been known for over 300 years and is reported to be widely distributed over West Africa but has not been found endemic beyond this region.

* From the Department of Ophthalmology, Temple University Medical School, Philadelphia, Pennsylvania. Read before the Section on Ophthalmology, College of Physicians of Philadelphia, December 19, 1957.

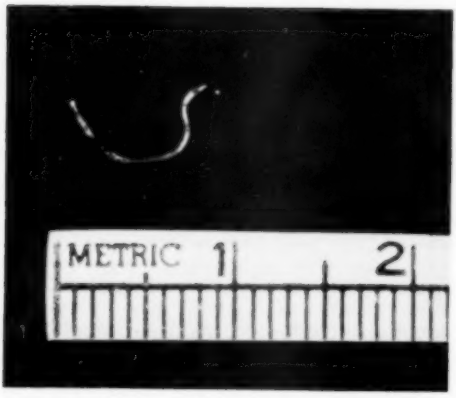

Fig. 1 (Harley). Adult Filaria loa, male, removed from left lower eyelid. The specimen has shrunken from fixation in 70-percent alcohol.

Pigafetta, in 1598, on his journey up the Congo River is said to have been the first to observe and record pictorially the Filaria loa. Mongin, in 1770, removed a worm from the eye of a Negress in Haiti. The specific localization of its intermediate host, the mangrove fly (Chrysops dimidiata or C. silacea), to this area indicates why this filaria is rarely seen beyond West Africa, unless transported. Manson[3] first suggested that the Chrysops, a diurnal, blood-sucking fly, was the intermediary host. Leiper[4] traced the development of the microfilaria in the salivary gland of the fly. After the mangrove fly has bitten man, the parasite matures slowly in the human host and rarely makes a subcutaneous appearance before one year. The fly characteristically bites about the lower leg and ankle.

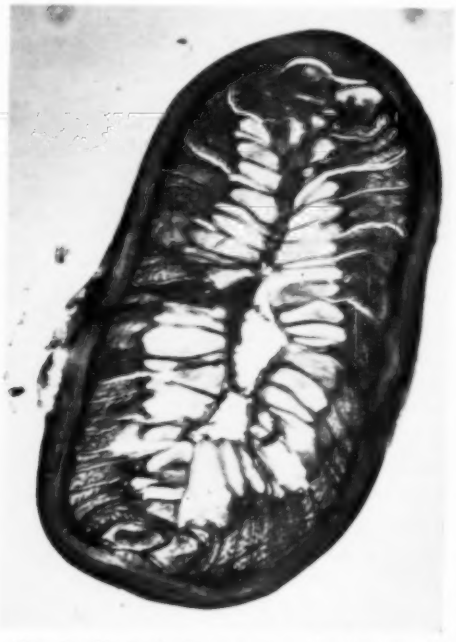

Fig. 2 (Harley). Cross-section of adult Filaria loa, male, near the anterior end. The specimen shows the central intestinal tract surrounded by muscular bands. (×200.)

The parasite

The parasite is represented in both sexes. The female is usually larger and longer ranging from 30 mm. to 70 mm. in length. The male worm measures 16 mm. to 34 mm. and resembles a 4-0 plain-gut suture. It is actively motile in the tissues and occasionally moves with alarming speed. In the male Loa loa the body is filled with a straight digestive tract, while the uterus filled with ova is prominent in the female. Special anatomic structures are present on the worms for reproduction and elimination. Loa loa is known to travel rapidly in the tissues especially the subconjunctival space. Regular paths in the subcutaneous structures are said to have been recognized.[2] Microfilaria or the larval form of Filaria loa can be recognized in the blood smear of the host patient characteristically during the daytime.

Clinical course

The first sign of a Loa loa infection is usually the occurrence of calabar swellings. It was originally believed that these painful swellings were due to the extrusion of microfilaria from the female worm. It now seems evident that they are the local anaphylactoid reaction of the host to the loa antigen.[9] They have been artificially produced by injecting

a similar type antigen from Dirofilaria immitis into patients with loiasis.[10] The presence of the worm in the subcutaneous connective tissues usually follows the appearance of calabar swellings. The parasites cause little inconvenience unless their activity is subconjunctival or in the lids. It has been described as a combination of itching, pain, and irritation resulting from worm movement.

The visits of the worms to the body surface occur at irregular times but frequently are stimulated by heat, such as sitting in front of a fire. Although worm movements are understandably distracting, it is usually considered to be a harmless disorder. However, Brunetiere[5] has described a right hemiplegia in a Loa loa patient which he reasoned was due to filarial blocking of the sylvian artery. The patient recovered and the diagnosis cannot be proved. Gabrielides[6] described a case of invasion of the anterior chamber by a Filaria loa. A severe cyclitis developed from invasion of the ciliary body and enucleation finally became necessary.

In endemic areas of Loa loa, 10 percent of the patients coming to surgery for hernia have live worms in the regions exposed.[9] Adult filaria have been found in every part of the body including the heart and pericardium.

Loiasis undoubtedly lasts a long time, since the parasite is said to be capable of existing about 14 years and Manson-Bahr[1] records a case in which microfilaria persisted in the blood for 17 years. Dr. R. D. C. Johnstone[9] recorded in the *Lancet* his own Loa loa infection and emphasized the severe psychologic effects which develop from the constant creeping sensation of the worm beneath the skin of the face for hours or even days.

Diagnosis

Cregar and Burchell[7] state that for diagnosis an adult worm should be found together with a history of having resided in endemic West Africa. Calabar swellings or a history of such swellings may be elicited. During the daylight hours microfilaria may be seen in the blood smear and a pronounced eosinophilia up to 50 percent has been recorded. The absence of microfilaria from the blood is no bar to the diagnosis, since they may be absent for a considerable period even in heavy infections. Eosinophilia is almost a constant finding but after a long period in a cold climate the count tends to return to normal.

Filaria loa is similar morphologically to Filaria bancrofti but as a rule does not obstruct lymphatics as does the latter worm. Filaria bancrofti is indigenous in the Pacific Islands and is responsible for the condition of elephantiasis.[8] The guinea worm or F. medinensis usually prefers the lower extremities where the female worm may attain lengths to two to three feet. It may be found in the subconjunctival space and has been reported to enter the eyeball.[11] F. lacrimalis or Thelazia are the common "eyeworms" found in dogs, horses, and cattle in southeast Asia. They have frequently been reported from human eyes and must be differentiated from Filaria loa.[8]

Treatment

The only effective treatment is surgical excision of the worm. Tartar emetic, Salvarsan, and Fuadin have been given without success.[7] A cure of one case was claimed for sulpharsphenamine. Anthiomaline, Stibophen, methylene-blue, and organic arsenicals have little effect when given in doses not toxic to the host. As a prophylactic measure high boots and thick stockings should be worn to frustrate the fly which has a tendency to bite the lower legs.[8]

Whenever the opportunity to remove the filaria is present, operation should be performed promptly because of the elusiveness of the worm. The worm should be grasped with small fixation forceps and several drops of a local anesthetic with adrenalin may be instilled. A 4-0 silk suture can be passed un-

der the parasite and tied tightly. With the worm held firmly in the suture, the overlying conjunctiva or skin is incised. The swaying extremity of the worm is grasped and the filaria extracted as the suture is cut. The parasite offers no resistance as it is removed from the incised area.

Summary

1. A Filaria loa was extracted from the subcutaneous region of the left lower eyelid of a missionary nurse from an endemic area in the Belgian Congo.

2. Since this filaria is not commonly seen in this country it provided an opportunity for a brief review of loiasis.

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I wish to acknowledge the assistance given by Dr. Edwin S. Gault, professor of pathology and microbiology, Temple University, for the photographic specimens.

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ATOPY AND KERATOCONUS*

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and

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The pathogenesis of keratoconus has proved an enigma since the earliest descriptions of this condition. It is clear, however, that the observable defects, that is, the slit-lamp changes, are all initially confined to the corneal elements nonectodermal in origin. Alterations occur in the corneal components derived from the paraxial mesoderm. The ectodermal derivative of the cornea, the epithelium, is altered only secondarily.

It would be logical, therefore, to search for a defect in mesenchymal development or maintenance in these patients, if one were to consider keratoconus part of a systemic disease. This concept has been advanced particularly by Badtke,[1] and considered by many others. Thomas[2] states: "Defective development or weakness of the mesenchyme from pituitary dysfunction and degenerative changes in the elastic tissue are also believed to be factors in the occurrence of keratoconus." Politzer[3] advanced the idea that perhaps inadequate proliferation of the mesoderm at an early embryologic stage leads to a weakened cornea which cannot withstand the normal intraocular pressure. However, no real mesodermal deficiency has been demonstrated in patients with keratoconus.

Certainly, ectodermal diseases have their counterparts in ocular disease in all aspects, many involving the conjunctiva and cornea, and others the lens. One of the dermatologic conditions, atopic eczema, has been reported associated with four distinct ocular disorders. These are (1) cataracts,[4] (2) keratitis superficialis punctata,[5] (3) atopic

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TABLE 1

ALLERGIC CONDITIONS PRESENT IN KERATOCONUS PATIENTS

Patient	Eczema	Hayfever	Asthma	Drug Sensitivity	Angioneurotic Edema
M. C.	+	+	+	+	
H. S.	+				
C. H.	+	+	+	+	
E. B.		+		+	
R. L.				+	
J. D.				+	+
J. W.	+ (Nummular eczema)			+	

keratoconjunctivitis,[6] and (4) keratoconus.[7] By far the commonest of these is cataract, first reported by Rothmund in 1868.[8]

The etiology of the cataracts associated with atopic eczema has been the subject of considerable speculation, unfortunately without satisfactory demonstration of allergic or other mechanisms. Carleton[9] has reviewed the dermatoses associated with cataract formation and noted in addition to atopic dermatitis, Rothmund's syndrome (poikiloderma vasculare atrophicans and cataract), Werner's syndrome (scleroderma, various developmental defects, and cataract), and her own case of familial telangiectasia, myotonic dystrophy and cataract.

Atopic eczema and keratoconus were first noted by Hilgartner,[7] and subsequently reported by Bereston and Baer,[10] and Brunsting et al.[4] It was thought, therefore, that a survey of our patients with keratoconus, with this association in mind, might prove informative.

Although a number of patients with keratoconus have been followed by the Department of Ophthalmology at The New York Hospital, relatively few have required hospitalization for surgery. During the past 15 years, there have been 14 patients admitted for corneal grafting necessitated by keratoconus. Of these 14, three had present or past histories of atopic eczema. In fact, the association of allergic phenomena was striking in the entire group. These phenomena may be codified as in Table 1. The atopic triad of eczema, allergic rhinitis (hayfever), and asthma was present, in toto, in two patients.

A summary of the case histories of these three patients follows.

CASE HISTORIES

CASE 1

H. S., a 22-year-old white man, was first seen in the pediatric clinic in 1936 (aged three years) for club feet. Shortly thereafter, eczema developed, and the child was under constant observation for eczema as an out-patient. In 1951 (aged 16 years), he came to the eye clinic because of a three-year history of visual loss. Keratoconus was diagnosed, and the patient treated with contact lenses. However, subsequently keratoplasty had to be done.

CASE 2

M. C., a 19-year-old woman, was admitted to the New York Hospital for the first time in September, 1954. This patient had experienced infantile eczema commencing at the age of four months, and asthma beginning at the age of four years. Her brother had asthma, and a cousin had asthma, eczema, and keratoconus.

At the age of eight years, the patient's eyes had been examined and found to be normal. However, at the age of 15 years, she noted progressive diminution of vision and was informed of keratoconus. A contact lens was prescribed with good results initially but the patient subsequently could not tolerate the lens. Strabismus surgery had been performed for exotropia, which had developed after the onset of keratoconus, about two years prior to this hospitalization.

Physical examination at the time of admission revealed ready evidence of her cutaneous and respiratory atopy. Examination of the patient's eyes disclosed the presence of bilateral keratoconus. Keratoplasty was subsequently performed bilaterally.

CASE 3

C. H., a 21-year-old white woman, was admitted to The New York Hospital in March, 1957. This patient was not clear on details but knew that her

poor vision could not be helped by glasses. She had eczema commencing as an infant; subsequently, she developed hay fever and asthma. Her family suffered from "psoriasis," and one grandfather had "psoriasis" and cataracts.

Physical examination disclosed marked skin changes of the type seen in prolonged and severe atopic eczema. Mild keratoconus was present on the right, and advanced keratoconus on the left, for which keratoplasty was performed.

Summary

Three cases of keratoconus, occurring in patients with atopic eczema, are presented, and a fourth is recorded via history. The high association of allergic phenomena in these patients is noted.

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BILATERAL CILIARY STAPHYLOMA

Following cataract extraction: A case report

Eugene T. Buckley, M.D., F. M. Green, M.D., and J. S. Nauheim, M.D.

Garden City, New York

Swan[6] pointed out that diseases of the sclera have received little attention in textbooks of ophthalmology. In the recent literature scleromalacia perforans seems to be the only entity that has received any amount of attention. Anderson and Margolis[1] have presented an excellent review of this subject. Articles and case reports on scleral staphyloma are relatively rare.

Morgan[5] reported a case of ciliary staphyloma in a six-year-old boy following needling for congenital cataract. There was some increase in intraocular pressure postoperatively and, five years later, a ciliary staphyloma developed. This was repaired by placing mattress sutures through the base of the staphyloma, tying them, and excising it. This patient did well postoperatively except for an attack of acute glaucoma which responded to eserine. He was then placed on the drug prophylactically.

Vail[7] reported eight cases of scleral staphyloma treated by scleral resection and diathermy. In his last two cases he utilized Morgan's technique and concludes that this operation is easier to perform than the more tedious excision previously employed. His histologic studies confirmed Mattice's[4] descriptions of the evolution and progression of staphylomas, in which it is assumed that a weakened area in the sclera begins to yield to normal or increased intraocular pressure. Since the scleral fibers are relatively inelastic, they break in successive layers. The scleral wall eventually becomes so thin that it yields to the force of the intraocular pressure, producing an ectasia.

Swan[6] resected a posttraumatic staphyloma in an eight-year-old boy. Histologically, fibrosis was not observed but some fibers were greatly thinned and some were disrupted. Swan states that the morphologic

Fig. 1 (Buckley, Green, and Nauheim). Appearance of eyes six months after resection of the ciliary staphyloma, O.S. Originally the staphyloma in the left eye was more pronounced than the one that remains in the right eye.

character of the fibers was changed without histologic evidence of a reparative process and feels that this type of physical reaction to injury is typical of collagenous tissues in areas which are relatively acellular and in avascular areas.

Case report

The following case is of interest not only because of the development of bilateral ciliary staphyloma following cataract extraction but because it was possible to repair the ectasia successfully.

J. B. was a 65-year-old Negress who was admitted to Meadowbrook Hospital on September 8, 1956, with a chief complaint of pain in the left eye of two days' duration. This pain was aggravated by moving the eye or looking at a bright light.

In June, 1948, she had had an intracapsular round-pupil cataract extraction, left eye, and on March 17, 1950, a similar procedure was done on the right eye. The procedure was conventional. Van Lint akinesia, retrobulbar injection of two-percent Novocaine, limbus-based flap, preplaced sutures of 6-0 silk, and a keratome incision were employed. The patient claims that she had a sore eye about two weeks after the second operation. Refraction on June 21, 1950, was: O.D. with a +10D. sph. $\bigcirc$ +1.75D. cyl. ax. 180°; O.S., −3.0D. sph. $\bigcirc$ +13.5D. cyl. ax. 30°; vision was: 20/40, O.D., and 20/40, O.S. At that time she had a very marked staphyloma of the ciliary body of the left eye which had begun to develop several months postoperatively. She also had an early staphyloma of the right eye.*

Relevant physical findings on admission were limited to the hands which showed osteoarthritic changes and to the eyes. The left eye had a small round pupil, marked conjunctival injection, and a protrusion of the uvea at the superior limbus. The fundus appeared normal except for a high degree of astigmatism. This eye had light perception with good light projection. The right eye had a less marked herniation of the uvea at the superior limbus. Corneal haze and vitreous opacities prevented visualization of the fundus.

In view of the presence of light perception and normal light projection in the left eye, it was decided to attempt excision of the area of herniation and resuture the limbal border, with a view to subsequent enucleation should this procedure fail.

On September 20, 1956, after Van Lint akinesia and retrobulbar anesthesia, a 3-0 black silk suture was placed in the superior rectus. Peritomy was performed and a conjunctival flap prepared. The area of prolapse was excised with a Graefe knife from the corneal side. Sutures were inserted as the incision was enlarged and the area of ciliary body was excised back through the sclera, with some loss of vitreous. Necrotic portions of the cornea were excised and the six previously inserted 6-0 chromic corneoscleral sutures were tied. An air bubble was inserted and the conjunctival flap was pulled over the wound. Atropine was instilled and the eye was dressed.

Postoperatively the patient was placed on five mg. of prednisone four times daily for two weeks and 300,000 units of penicillin, O.D., for four days. From October 3rd to October 6th she received 2.5-percent cortone ointment in the conjunctival sac every three hours. The postoperative course was uneventful. By September 28th (eight days postoperatively) she was able to count fingers at six inches. When last examined on June 17, 1957, her prescription was: O.D., plano on a +11.0D. cyl. ax. 70°; O.S., +6.0D. sph. $\bigcirc$ +5.0D. cyl. ax. 150°; with a +3.5D add, O.U.; vision was: O.D., 20/100; O.S., 20/40.

*We thank Dr. William Y. Sayad for his cooperation in sending a summary of the case.

There was no evidence of flare or keratic precipitates on slitlamp examination and tension was normal. When the patient came in for photographs on March 7, 1957, the conjunctiva were still somewhat injected but she was comfortable. Finger tension seemed normal and the wound in the left eye appeared well healed and without evidence of recurrent staphyloma.

Discussion

This case may represent an incisional herniation of the ciliary body instead of a true staphyloma, since wound dehiscence rather than scleral thinning is more likely to be the underlying factor. It is interesting to note that this complication is not commonly mentioned in the literature, although we suspect that it is not as rare as this would lead one to believe. Gleidman and Karlson[3] used the occurrence of staphyloma as one of the criteria for rejecting cats' eyes in their experiment on the tensile strength of healing limbal incisions. Dunnington[2] states that gradual separation of wound edges is not uncommon and that tissue incarceration or abnormal healing are to be expected when this occurs. In his review of 171 globes removed after cataract extraction, he found tissue incarceration in 31 percent. He mentions the incarceration of iris, lens, and vitreous, but not of ciliary body. It is possible that the ciliary body was involved in some of the cases rejected from the study because of sympathetic ophthalmia, endophthalmitis, retinal detachment, and secondary glaucoma; this is, however, mere speculation.

Inspection of the results obtained by Gleidman and Karlson[3] in their investigations of the strength of healing limbal incisions in cataract surgery makes one wonder why wound separation of high degree is not the rule rather than the exception. By the 14th day wound strength was only 34 percent of normal limbus. Even at six months it was only 62 percent of normal.

Certainly stress must be placed on the wound in order to cause separation of the edges. This could be internal, as in Morgan's case which was secondary to attacks of glaucoma. It could result from external trauma as in a case seen at this hospital several months ago, in which a patient sustained trauma to her aphakic globe which ruptured at the site of the limbal incision. Yet many cases develop glaucoma and sustain trauma without rupturing the limbal wound and prolapsing the intraocular contents.

Faulty wound healing might well be another factor involved in the separation of edges at the site of incision. Swan[6] discusses the case of a 69-year-old woman in whom, even one year after cataract extraction, the limbal incision was visible as a dark line with direct illumination and as a transparent line with retro-illumination. He apparently considered this patient as having scleromalacia and states that there is little fibroblastic proliferation in this disease.

X-ray studies of the hands of the patient presented herein showed only osteoarthritic changes. Agglutination of sensitized sheep cells, which is of value as a specific test for rheumatoid arthritis, was negative. One can, therefore, be relatively sure that this patient did not have rheumatoid arthritis. This finding plus the lack of typical scleral ulcerations and a more benign course make scleromalacia an unlikely etiologic factor in our case.

Prior to surgery, any attempt to repair this lesion was felt to be futile. Since vision in the other eye was very poor and as there was little else to offer this patient, the procedure was undertaken. Had the second eye been relatively normal with good visual acuity, we would probably have considered enucleation as the primary procedure. The success of this case added to that of Morgan suggests that it might prove worth while to attempt the repair of a ciliary staphyloma even in the presence of a normal second eye. Certainly such a procedure cannot be undertaken lightly. Adequate coverage with antibiotics and corticosteroids and careful postoperative observation for evidence of sympathetic involvement of the other eye are essential. It would seem good judgment to un-

dertake this procedure if vision in the second eye is poor.

Summary

A case of bilateral ciliary staphyloma following cataract extraction is presented. Successful excision and repair of one staphyloma is described. Among the factors which may be involved in the etiology of such an ectasia are weakness at the site of incision, stress on the wound site, and faulty wound healing.

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EXTRACTION OF POSTERIORLY LUXATED CATARACT FROM FLUID VITREOUS

A case report

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The following case is being reported because it presents the difficult problem of extracting a completely luxated cataract from fluid vitreous. There were also some rather unusual features present which posed multiple problems in diagnosis and management.

Case report

History. A. L., a 40-year-old white man, was first seen in the office September 10, 1955. He stated that he had recently regained some vision in his previously blind right eye.

His past history revealed an eye injury in 1936 when he was struck in the right eye with a piece of metal from a steel cable. He was treated briefly by a physician who bandaged the eye for three days but he recalled no X-ray studies being made. He was asymptomatic thereafter except that vision in the right eye gradually failed over the next three years and remained limited to light perception until he struck his head on a door three days before my initial examination. Immediately after this minor injury, he noted he could see gross objects again with the right eye and was suddenly aware of diplopia.

Examination of the right eye showed visual acuity to be 20/400 correctible to 20/25 with a +10D. sph. There was 10 degrees of right exotropia with diplopia. The globe was white and the sclera unscarred. Except for fine pigmented keratic precipitates, the cornea was clear. The anterior chamber was deep and clear except for an occasional cell but there was stromal iris atrophy and the right iris was a darker brown than the left. Iridodonesis was present. The pupil which was one mm. in diameter could not be dilated beyond 1.5 mm. A good view of the entire fundus was therefore impossible but it appeared grossly normal except for a gray mass in the vitreous inferiorly which resembled a shrunken hypermature cataract. The tension measured 23.4 mm. Hg (Schiøtz) in the right eye and 16.9 mm. Hg in the left.

The left eye was normal throughout with uncorrected visual acuity of 20/15.

X-rays films of the right eye revealed a metallic intraocular foreign body 1.0 by 3.0 mm. in size which, by Sweet localization, was reported to be 8.0 mm. behind, 4.0 mm. below, and 7.0 mm. temporal to the center of the cornea.

A diagnosis of metallic intraocular foreign body with siderosis of the iris and recent posterior luxation of a hypermature traumatic cataract was made.

At this time surgery for attempted removal of the foreign body and/or the luxated cataract was discussed with the patient who wished to avoid surgery if at all possible. He agreed to return for frequent observation of both eyes but failed to do so until May, 1956, eight months later, when the eye had become red and painful. Examination at this time revealed an acute iridocyclitis of the right eye and the best corrected vision was reduced to 20/200. The tension measured 8.7 mm. Hg.

He was treated with local hydrocortisone, atropine, and hot compresses which, in three weeks,

brought about only moderate improvement. Systemic prednisone was then resorted to with immediate subsidence of acute symptoms.

It was felt that the iridocyclitis was due to the luxated cataract and the patient was strongly advised to have surgery for its removal but declined and failed to return for further evaluation until a second episode of acute iridocyclitis occurred three months later. This again was controlled with local and systemic steroids only to recur again when systemic prednisone was discontinued.

The patient finally agreed to surgery. It was decided that a preliminary iridectomy and an attempt to remove the foreign body would be done as an initial procedure, with extraction of the cataract at a future date. On November 3, 1956, a preliminary wide basal iridectomy was performed superiorly. Before the anterior chamber was entered, however, a conjunctival opening was made over the area in which the foreign body had been localized and a Sweet magnet was brought in contact with the sclera but no visible magnetic response was noted and the sclera was not opened.

The eye tolerated this procedure well and healed without complication. It was then possible to examine the fundus without difficulty. The cataract was found to be completely free in fluid vitreous and would sink rapidly to the posterior pole when the patient's face was turned up and would come forward against the iris but not into the anterior chamber with the face turned down.

X-ray studies of the area in which the foreign body was localized, taken with the face up and then down, showed no change in the position of the foreign body. There was noted to be scar tissue in the peripheral vitreous temporally near where the foreign body had been localized but no foreign body could be seen and no objective or subjective response was noted when a magnet was brought against the globe at this point.

On December 6, 1956, the extraction of the cataract was performed. A fornix-based conjunctival flap was used and a limbal section made temporally from the 7-o'clock to the 1-o'clock positions, with the thought of possibly later resorting to Bracken's[1] method of turning the patient over face down and extracting the lens temporally if all other efforts failed. The iridectomy was widened temporally and an attempt was made to float the lens forward by irrigation with saline, as described by Verhoeff.[2] Under direct observation with the corneal flap elevated, the lens was seen to swirl around in the fluid vitreous posteriorly but was too heavy to rise. A Bell erisophake was then passed back to contact the cataract near the posterior pole and it was successfully grasped and removed without complication.

The extracted cataract was dark brown, shrunken, and of dense rubbery consistency but the foreign body was not contained within.

Postoperative healing was very satisfactory with rapid clearing of the iridocyclitis. The posterior pole appeared normal except for slight narrowing of the arteries and no change was noted in the peripheral scarring temporally. Vision can now be corrected to 20/60; tension is 18.8 mm. Hg, and the eye has remained quiet and asympotomatic without treatment for the past seven months. The left eye has never shown any sign of sympathetic uveitis.

Discussion

In reviewing the literature and standard reference books, it is noted that several techniques are described for dealing with a completely luxated cataract in the posterior vitreous. Most authors suggest conservative management in the absence of such complications as iridocyclitis or glaucoma. If forced to operate, Duke-Elder[3] suggests that the pupil first be dilated and the lens trapped and held in the anterior chamber by placing the patient in a prone position. Failing this, he suggests an attempted loop extraction but considers this a heroic measure with a poor prognosis.

The use of the electrodiaphaque of Lopez-Lacarrére has been reported by Callahan[4] as having been unsuccessful in several cases and he found more success using the technique described by Verhoeff[2] of floating the lens to the anterior segment by directing a stream of saline into the vitreous.

Kirby[1] describes a technique he learned from Bracken who, after making the incision, had the specially robed and draped patient turned over from the supine to the prone position so that the lens dropped into the anterior chamber from which it was removed with a loop.

The careful use of an erisophake, as described in the case reported here, would seem less hazardous and more likely to prove successful than the other methods just described. It is necessary, of course, that the vitreous be fluid and not formed. The lifting of the corneal flap is most important so that the lens can be directly visualized. It is easily seen with an ordinary overhead light if cataractous, and with ultraviolet light if clear. The erisophake can then be carefully lowered until it can be seen just to make contact with the lens. This contact is best detected by moving the erisophake slightly from

side to side as it descends and noting the depth at which the lens is touched. Of course, the danger of introducing the erisophake too deeply into the eye must be kept in mind, as any contact of the instrument with the retina must be avoided.

Summary

A case report has been presented of the successful removal of a posteriorly luxated cataract from fluid vitreous. This was accomplished by use of an erisophake. A review of the literature for other techniques used for this procedure suggests that erisophake extraction might well be the method of choice.

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METHOD FOR REMOVAL OF NONMAGNETIC FOREIGN BODIES*

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The removal of nonmagnetic foreign bodies is mainly a problem of visualization during the extraction. Instrumentation, by means of some appropriate forceps is also important (Stallard[1]). It is Dixon[2] who has come nearest to ideal visualization by using a glass slide to eliminate the refraction of the cornea. My method is based upon his in so far as the corneal refraction is neutralized by means of a special contact lens (fig. 3).

The instrument is newly developed and is called a needle-forceps. It can be introduced through a narrow opening and is capable of refilling the anterior chamber before one proceeds to extraction. A foreign body once grasped is held by the active force of the instrument. The shaft of the device is held like a pencil and the forceps are opened by digital pressure; no displacement of the tip occurs during this action. The device is essentially an injection needle with a forceps protruding from its tip (fig. 1).

It was first used on enucleated pigs eyes as follows:

Experimental

Case 1

A foreign body was to be removed from the anterior chamber and the needle forceps was prepared for this by attaching a syringe and a tube to it (fig. 1). The system was filled with isotonic salt solution.

The anterior chamber was opened by a small limbal incision opposite the foreign

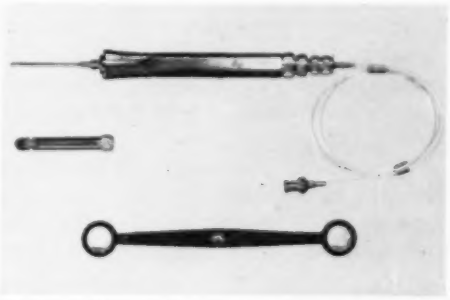

Fig. 1 (Worst). Needle-forceps. Contact lens for extraction of foreign bodies from the vitreous. Tube attached for the extraction from the anterior chamber.

*I am indebted to K. Otter, instrument maker, for his ingenious help. All instruments mentioned are currently made in his workshop, Medische Instrumentmakerij, van Imhoffstraat 3, Groningen, Holland. The drawings were kindly made by my colleague, E. D. Eggink.

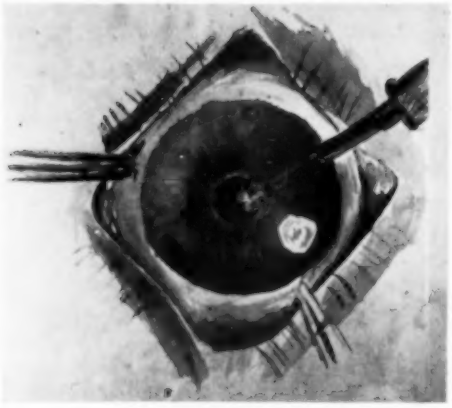

Fig. 2 (Worst). Extraction from the anterior chamber.

body. This produced the common disadvantages of an anterior chamber extraction: draining of the anterior chamber, flattening and wrinkling of the cornea, producing an optically poor medium, and fixation of the foreign body.

The forceps was pushed into the anterior chamber while an assistant restored it by slowly injecting "aqueous." In a filled anterior chamber the often notoriously difficult operation of removing a foreign body becomes an easy matter (fig. 2).

The forceps are opened by pressure on the three flat springs which can be seen in Figure 1. After releasing the pressure, the forceps will hold the foreign body of its own accord.

A foreign body incarcerated between cornea and iris or entangled in the chamber angle could be freed by raising the pressure above normal values, thus deepening the anterior chamber considerably.

These procedures can be carried out under an operating microscope which facilitates the removal of small foreign bodies or those consisting of transparent material.

Case 2

A foreign body was ophthalmoscopically observed in the posterior part of the eye.

By means of a contact lens (figs. 1 and 3), the corneal refraction was neutralized. With a headlamp of sufficient strength the fundus was visualized stereoscopically and unenlarged. An ideal situation, however, might be obtained with an operating microscope which offers the combined advantages of depth of focus, stereoscopic image, and magnification.

The forceps was introduced through a scleral incision in the pars plana. The foreign body was approached with some care, grasped, and extracted. One has to take into account the slightly gelatinous properties of the vitreous (Stallard,[1] Thorpe[3]). In a transparent medium extraction is astonishingly simple.

Discussion

The techniques described postulate an uninjured lens. For cases with traumatic cataract some way to visualize the interior of the eye is necessary if extensive injury to the structures is to be avoided. A complicated instrument like the Thorpe intraocular endoscope (Thorpe[3]) was designed for this purpose but the objections to its use are many. To help solve the problem, an experimental surgical procedure was developed.

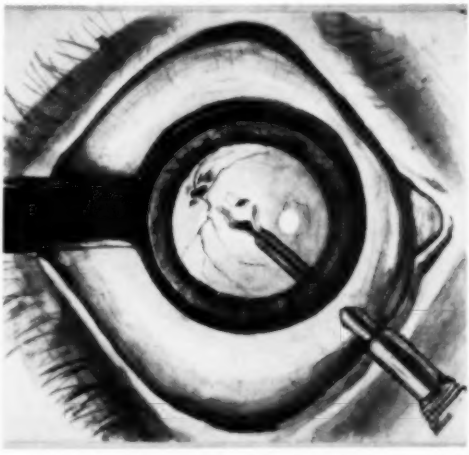

Fig. 3 (Worst). Extraction from the vitreous with the help of a contact lens.

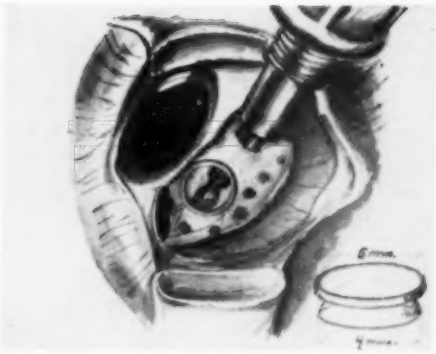

Fig. 4 (Worst). Scleral window for viewing the fundus of a cataractous eye. (Insert) Scleral button.

A trephine incision is made halfway into the sclera of the pars plana, and sutured with the Lindner-Mendosa technique. The circular incision is dissected down to the choroidal coat and the trephined "lid" is removed. Preventive measures are taken against choroidal hemorrhage (coagulation, epinephrine, and thromboplastin, see Thorpe[3]). If the choroid bulges out into the trephined hole, the intraocular pressure is lowered by puncturing the anterior chamber. The choroid at the bottom of the trephined hole is dissected away.

With a special forceps a "perspex" button, the dimensions of which are given in the insert of Figure 4, is placed over the hole and pressed into it. The button is shaped like a stud and acts in the same manner. If the scleral window is exactly fitted, no vitreous can be lost.

Strong illumination of the pupillary area now provides an astonishingly beautiful view of the interior of the eye. The scleral porthole may be tilted with the forceps so that areas not frequently seen, as the equator of the lens and the ciliary body, may be readily visualized. Even in the vitreous, if it is not too obscured with blood, a foreign body can be recognized.

The foreign body is removed with the needle-forceps, as is described in the experimental Case 2. The scleral lid is sutured with the preset sutures.

Summary

In these experimental studies, nonmagnetic foreign bodies were made more attainable by the use of the anterior chamber refilling forceps in conjunction with a contact lens and a scleral window.

van Starkenborghstraat 10.

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UNIVERSAL SLITLAMP ATTACHMENT*

For plotting unilateral central scotomas

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The accuracy of a visual field study is only as good as the fixation is steady. With standard central visual acuity and with a reasonable degree of attentiveness the results are acceptable, but with markedly reduced central acuity the fixation is too unsteady to yield reliable results. This problem can be overcome in the case of unilateral central scotoma by the unilateral application of the principle used in the Wheatstone stereoscope. This principle has already been applied to the campimeter, the cheiroscope, the amblyoscope, and the haploscope used in stigmatoscopy.

* From the Eye Clinic, United States Army Hospital.

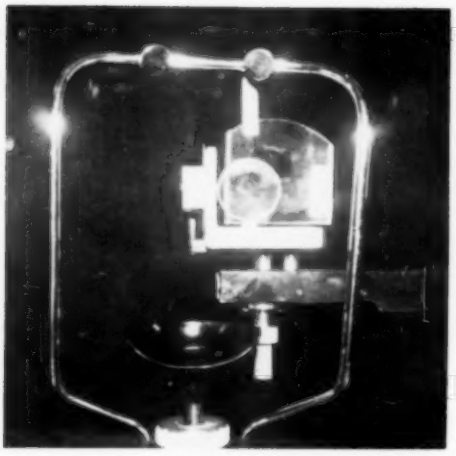

Fig. 1 (Hilton). Attachment in place for plotting the visual field of the left eye. Disregard silvering flaw in mirror.

This note describes a simple home-made attachment for use with the Bausch and Lomb Universal slitlamp, which converts it into a one-arm haploscope to be used with the tangent screen. This attachment can be made by any "week-end mechanic" and is inexpensive. Materials will cost less than one dollar.

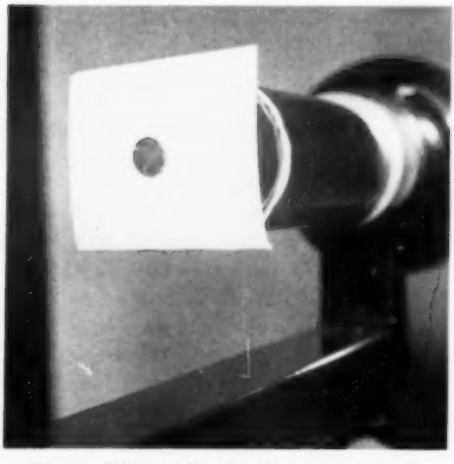

Fig. 2 (Hilton). The fixation point attached to lamp housing.

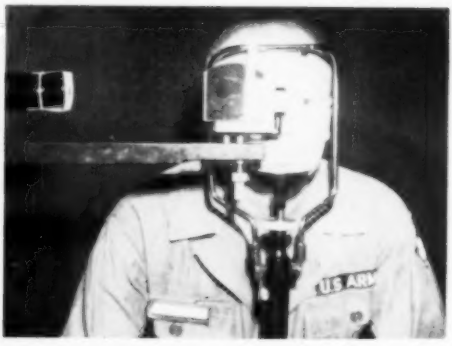

Fig. 3 (Hilton). The attachment positioned for plotting the field of the left eye.

This attachment is made of wood, a pocket mirror, and a three diopter convex lens from the trial lens set. Its main features and method of attachment are shown in Figure 1. The attachment is held in place by a groove in the bottom surface which fits snugly over the three-eights inch bar of the slitlamp arm. The adjustability of the slitlamp arm will permit the mirror to be positioned before the fixing eye.

The fixation point, in this case a thumb tack, is attached to the slitlamp housing and is readily viewed in the mirror (fig. 2). The mirror also serves as an occluder for the fixing eye and therefore only the scotomatous eye has a view of the tangent screen (fig. 3).

By adjusting the angle of the mirror about its vertical axis, the visual axis of the scotomatous eye can easily be made to pass through the center of the tangent screen, and compensation can be made for any lateral heterophoria. The patient is instructed to fixate the thumb tack continually. By turning the mirror this apparatus can be used for either eye.

The optics of this setup are shown in Figure 4. The optical path from the fixation point to the fixing eye is 25 cm., providing a stimulus to accommodation of four diopters. But it is necessary to have the eyes accommodated only one diopter because the tan-

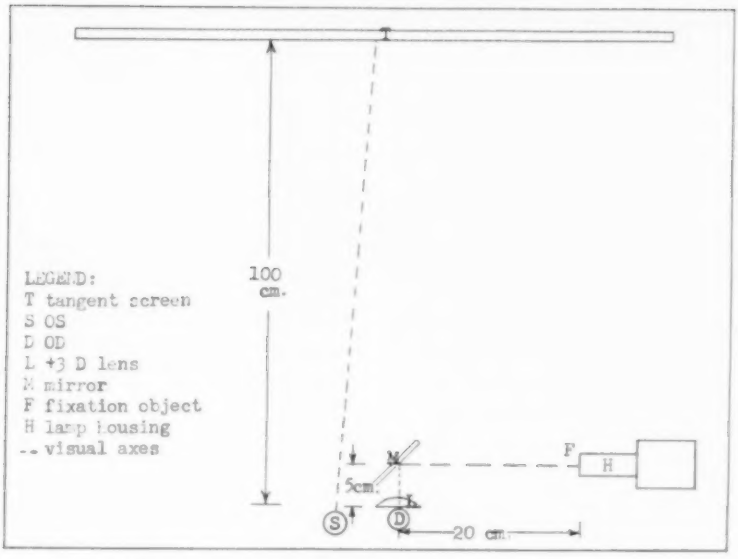

Fig. 4 (Hilton). Overhead view: Patient, attachment, and tangent screen.

gent screen is at a distance of one meter.

A three-diopter convex lens is, therefore, interposed before the fixing eye and this images the fixation point at one meter and provides the requisite one diopter stimulation to accommodation. The eye to be studied will be accommodated for the plane of the tangent screen. The +3.0D. lens may be fastened to the front edge of the attachment.

In addition to providing the proper stimulus to accommodation the convex lens also magnifies the fixation object ×4. Therefore, a very small fixation point, which will still have a reasonably small subtense after magnification, would be required in order to demand precise fixation. A pinhead would be more satisfactory than the thumb tack shown here.

This attachment has been used several times with good results.

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SCHEPENS' BINOCULAR INDIRECT OPHTHALMOSCOPE*

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The purpose of this paper is to encourage the wider use of the Schepens' ophthalmoscope and to dispel doubt as to its value. It is indeed a remarkable instrument and is far superior to the direct ophthalmoscope in the following respects:

1. PENETRATION

Penetration through hazy media is the characteristic of this ophthalmoscope which will most often prove helpful to the average ophthalmologist. The following examples will commonly be encountered in practice.

A. *Hemorrhage.* Frequently trauma results in vitreous hemorrhage sufficiently dense to obscure details as observed by the

* From the Department of Ophthalmology, The Ohio State University.

direct ophthalmoscope. A high proportion of these cases will permit observation of the fundus with the Schepens' ophthalmoscope. Accurate assessment of the extent of injury can thereby be made days or weeks before the fundus is visible by ordinary methods. Should a detachment be present, the course of treatment may be materially altered through use of the indirect ophthalmoscope.

B. *Inflammation.* Intense foci of chorioretinitis can completely conceal themselves behind a vitreous haze. Indeed, it is possible that confusion may exist between chronic uveitis, some instances of melanoma, or occasional cases of detachment with marked vitreous reaction. Only the most severe cases of uveitis will completely block study of the fundus with the indirect ophthalmoscope. Response of the active lesion to therapy can be assessed much more accurately by direct observation than by waiting for clearing of vitreous haze (which may persist for long periods after the lesion becomes quiescent).

C. *Cataract.* Not infrequently a patient is first seen when dense lens opacities completely obscure observation of fundus details. Ordinarily at least the better eye will still permit examination by the indirect ophthalmoscope. Discovery of macular degeneration, diabetic or hypertensive retinopathy, old scarring, retinal detachment, glaucoma, and so forth, will certainly alter the prognosis and may lead the ophthalmologist to more intelligent recommendations as to which eye to choose for surgery.

D. *Retinal diathermy surgery.* The care required to maintain corneal clarity at the time of surgery is well known. Minor surface irregularities often materially block direct ophthalmoscopy, to the great detriment of accurate localization. Indirect ophthalmoscopy gives a much clearer view under these circumstances.

2. Field of view

The considerably larger field of view provided by the indirect ophthalmoscope is gained at the expense of magnification, admittedly a loss. This wider field is most useful in a variety of circumstances:

A. *General screening.* The whole extent of a fundus can be surveyed much more rapidly, with less possibility of missing an isolated lesion.

B. *Gaining a concept of over-all relationships.* If an extensive pathologic alteration exists, considerable time must be spent in discovering the relationship of one part to another. This point will become very evident to anyone drawing a picture of a large fundus lesion. The broad field of the indirect ophthalmoscope permits such a lesion to be encompassed by only two or three fixations.

C. *Avoiding the nuisance of slight eye movements.* Even though 10- to 15-degree movements take place, details of disc, macula, vessels, or pathologic lesions may be studied fairly well. I have found this helpful in the examination of unanesthetized infants.

D. *Detecting gradual changes of elevation.* A depression as large as the usual posterior staphyloma is surprisingly easy to overlook when studied with the small field of a direct ophthalmoscope. These staphylomas are readily recognized with the indirect ophthalmoscope. Similarly, the slight elevations produced by extrabulbar tumors, choroidal angiomas, or flat detachment are more easily detected.

E. *Better view of far periphery.* It is routinely possible to see several disc diameters further in the periphery with the indirect ophthalmoscope than by the direct method. Scleral depression techniques render visible still more peripheral areas. Considerable emphasis should be placed on the absence of distortion in this peripheral view. The astigmatism of oblique incidence severely blurs views of the far periphery obtained by the direct ophthmoscope and makes many fine details unrecognizable. The indirect ophthalmoscope will resolve these pigmented blurs into a clearly recognizable focus of peripheral cystic degeneration, a

cluster of small hemorrhages, or perhaps a tiny retinal tear.

3. Ease of manipulation

The nonindirect ophthalmologist will stoutly and rightly maintain that the indirect ophthalmoscope is a monstrosity which is not nearly as maneuverable as the hand ophthalmoscope. In special cases, however, it is valuable:

A. *High refractive errors.* Particularly in the egg-shaped eye of a degenerative myope it is necessary to focus constantly between peripheral and posterior views. Auxiliary minus lenses may be necessary. Even with ideally clear media and proper lenses, a −35D. myope is not easily examined. One of the most dramatic illustrations of the value of the indirect ophthalmoscope is the brilliant and clear view of such a myopic fundus. Compensation for very large refractive changes is made by simply moving the focusing lens slightly back and forth.

B. *Elevated lesions.* Study of a retinal detachment or melanoma requires constant focusing. Much skill and attention are necessary to avoid missing details in an undulating area of varying focus. The indirect ophthalmoscope provides a considerably greater depth of focus ideally suited for such a case. Varying the distance of the focusing lens from the eye rapidly and simply brings different elevations into view.

C. *Detection of vitreous opacities and foreign bodies.* The previously mentioned ease of changing focus, combined with wide field of view and penetrating power, makes the indirect ophthalmoscope an ideal instrument with which to search for intraocular foreign bodies. It is well suited for the manipulations required in removal of a nonmagnetic foreign body from the vitreous.

D. *Retinal diathermy work.* Dr. Schepens has adequately publicized the many advantages gained from control of detachment surgery by simultaneous indirect ophthalmoscopy. I am in complete accord.

4. Brilliance of illumination

Adequate voltage is available to provide an extremely bright light source. This very high intensity of illumination is most helpful in recognizing fine details such as tiny holes obscured by slight haze of the vitreous. For some reason there is an inherent brilliance in the image even at low illuminations. The constant user of the indirect instrument is sometimes annoyed by dullness of the fundus view as seen by the direct ophthalmoscope. Objections have been voiced to the Schepens ophthalmoscope on the ground that it is too bright for the patient to tolerate. This may be true of many normal eyes, but one must remember that the most important use of this ophthalmoscope is the study of diseased eyes which do not fully perceive light. It is often possible to examine such an eye with the full intensity of light, with no discomfort to the patient. Even the slightest flash of this powerful beam into his normal eye will, of course, result in severe photophobia.

5. Depth perception

Inasmuch as this is a binocular instrument, a stereoscopic view of depth is obtained. This is particularly useful in detecting slightest elevations which are often inapparent with the direct ophthalmoscope. This stereopsis is most valuable in controlling the removal of nonmagnetic foreign bodies from the vitreous.

It would be most unfair to leave the impression there are no disadvantages to the indirect ophthalmoscope. Chief among these is the fact that under ordinary conditions some months will be required to achieve proficiency in its use. As a resident I used this instrument for two weeks and discarded it as useless. In practice, I placed it on my examining table and used it during the course of routine examinations of at least a half dozen patients daily. It was at least six months before I could use it effortlessly and

freely. I now find the indirect ophthalmoscope markedly superior to the direct ophthalmoscope in a large variety of selected conditions. At first, however, the inverted image, the small magnifications, the maddening loss of focus, and the irritation of discovering that the upper eyelid is being examined are discouraging.

Despite remarkable designing and engineering achievement, the indirect ophthalmoscope remains far more bulky than the direct ophthalmoscope. It requires a wall source of electric current. More time is consumed in adjusting it than in picking up a direct ophthalmoscope. All its advantages are lost through an undilated pupil, which becomes extremely miotic when exposed to the bright light.

SUMMARY

The Schepens' binocular indirect ophthalmoscope has several qualities which provide real diagnostic and operative advantages to the ophthalmologist familiar with its use. These advantages justify the time spent to acquire proficiency in indirect ophthalmoscopy.

Department of Ophthalmology,
University Hospital (10).

A FOUR-PRONGED HOOK*

FOR USE IN LAMELLAR KERATOPLASTY

CONRAD BERENS, M.D.
New York

The successful results following a lamellar keratoplasty depend largely upon the proper selection of the case, a good donor graft, and minimal trauma to it.

To minimize injury to the graft, a four-pronged hook has been devised which lessens the necessity of grasping the donor graft with forceps or using sutures for traction, and spreads pull more evenly over a broader surface.

Fig. 1 (Berens). A four-pronged hook with flexible shaft for use in lamellar keratoplasty.

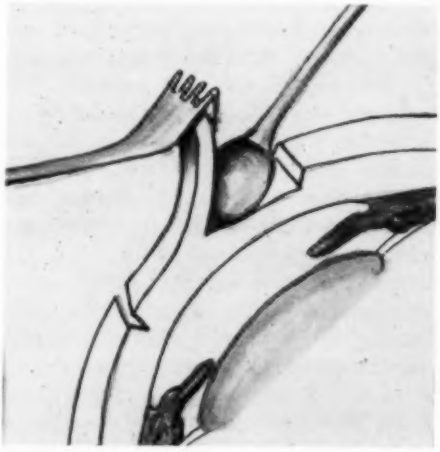

Fig. 2 (Berens). A hollow-ground rounded corneal dissector is employed until the prongs of the hook can engage the corneal section to be excised.

The four prongs of the hook† which are two-mm. long, are bent at an angle of 45 degrees, with sharp tips to engage the tissue without tearing. The shaft of the instrument is flexible and may be bent (fig. 1) to facilitate the application of the prongs to the graft.

* This study was aided by a grant from The Ophthalmological Foundation, Inc. and the Department of Research, New York Association for the Blind, and the Department of Ophthalmology, New York University Post-Graduate School of Medicine.

† Made by Storz Instrument Company, Saint Louis, Missouri.

A trephine is used to penetrate the donor cornea to the desired depth and the cornea is undermined slightly with a Paufique angular knife, continuing the excision with the Barraquer flat round dissector,[1] or a hollow-ground rounded corneal dissector until the prongs of the hook can engage the corneal section to be excised (fig. 2).

While using sufficient traction to reveal the line of cleavage between the corneal stroma and the area being excised, the hollow ground round keratectomy knife,[2] held flat against the wound bed, is moved carefully from side to side until the corneal graft is freed.

The diseased corneal section is now removed from the recipient eye in a similar manner and the graft, which has been kept on the donor eye in a moist plastic chamber,[3] is transferred to the recipient eye and carefully sutured in place.

708 Park Avenue (21).

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3. ———: Corneal transplantation: Special reference to plastic moist chamber for donor eye. Arch. Ophth., **48**:634 (Nov.) 1952.

NEWER CORNEAL TYPES OF CONTACT LENSES*

JACK HARTSTEIN, M.D.
Saint Louis, Missouri

Plastic corneal contact lenses were first introduced into the United States around 1948. Since then, there have been basic changes in both the principle and design of these lenses.

The original corneal type lens was 11 to 13 mm. in diameter with a thickness averaging 0.3 mm. It was fitted flatter than the flattest meridian of the cornea (0.25 to 0.75 mm. or flatter, depending on the individual manufacturer). This resulted in the lens having a central or apical touch and clearing the cornea at the periphery.

The Microlens was the next corneal type lens to appear (around 1953). In principle, it is the same as the basic corneal lens in that it rests on the apex of the cornea and clears the periphery; however, as the name implies, it is a smaller lens, with diameters averaging 9.0 to 10.5 mm. and the thickness is also reduced (0.1 to 0.2 mm.). This was the last of the corneal type lenses with the so-called "conventional fluorescein pattern" (central touch and periphery green). The newer lenses (which will be referred to in the following paragraphs as Lens A, Lens B, and so forth) depart radically from earlier designs.

Lens A averages 6.0 to 7.0 mm. in diameter and is fitted exactly parallel to the cornea. This lens is the smallest of the corneal lenses and is fitted so that it parallels the central or spherical zone of the cornea. The fluorescein pattern should fill the entire lens evenly, showing no undue central or peripheral pressures.

Lens B averages about 11 mm. in diameter and is also fitted parallel to the cornea. As the periphery of the cornea flattens so does the lens; it, too, shows a uniform fluorescein pattern.

Lens C averages about 9.0 mm. in diameter and is fitted so that it clears the apex of the cornea. It rests in the midzone of the cornea and clears in the periphery. The fluorescein pattern would show a central green area, a peripheral green circle, and a midzone rest area.

Lens D, like lens C, also clears the center

* From the Department of Ophthalmology, Saint Louis City Hospital.

of the cornea but instead of resting in the midzone of the cornea, it rests on the periphery of the cornea. To prevent suction, two "ventilation" holes are placed on the peripheral rim of the lens. This lens averages 10 to 10.5 mm. in diameter. The fluorescein pattern would show a central green area and a peripheral black circle of rest.

Lens E, like lenses C and D, is also fitted so that it clears the apex of the cornea. This lens varies from 8.0 to 9.0 mm. in diameter (but may be larger if necessary) and like lens D rests on the cornea by means of its peripheral rim. This lens is provided with four equidistant peripheral half-moon-shaped grooves.

1515 Lafayette Stret (4).

A NEW DEVICE FOR ROTATING THE SLITBEAM*

For use in slitlamp gonioscopy of the horizontal meridians

M. Wallace Friedman, M.D., and Malcolm Good, Sc.M.
San Francisco, California

The Haag Streit slitlamp after Professor Goldmann includes a single mirror contact glass for gonioscopy. This lens works well in the observation of the angle in the superior and inferior areas where the illumination is a slit. In the temporal and nasal areas the vertical slit produced by the lamp gives a general illumination and the view is less useful.

The purpose of this report is to describe a new instrument which makes it possible to rotate the slit to any given axis. The optical design of the Goldmann slitlamp makes this possible. This rotating slit increases the usefulness of the slitlamp when used for gonioscopy with the Goldmann, Zeiss, or Allen-Thorpe gonioscopy lenses, as well as the Goldmann three-mirror contact lens.

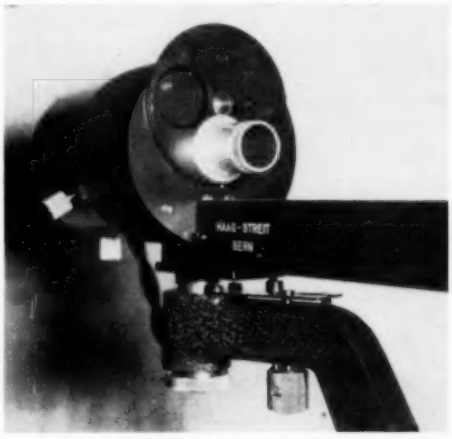

Fig. 1 (Friedman and Good). Device for gonioscopy mounted on the recross disc of the Goldmann slitlamp to obtain a slit in any desired axis.

The slitbundle is produced in a Goldmann slitlamp by imaging (with the illuminating lens) the plane of the guillotine at the forward part of the lamp housing. It does not image the bulb filament as did the earlier Zeiss models.

The following device has been found satisfactory to obtain a clear image in all areas:

A brass ring of 24-mm. diameter is mounted on the recross disc replacing the gray lens. On the ring an auxiliary housing is fastened. The housing consists of an aluminum tube, 17-mm. in diameter and 19-mm. in length. The posterior end of the tube is a solid plate in which has been cut a slit 1.0-mm. wide and 13-mm. long. The housing may be freely rotated inside the brass ring.

If the gray lens in the recross disc in the forward surface of the lamp housing is replaced with the slit-device pictured (fig. 1),† a rotating slit is produced. Since it is substantially in the plane of the guillotine it produces a slit in the same optical fashion. The imaged slit is 5.0-mm. long and 0.5-mm. wide. It is not adjustable but this size has

* From the Division of Ophthalmology, Department of Surgery, Stanford University School of Medicine.

† Made by Jenkel-Davidson Optical Company, 366 Post Street, San Francisco 2, California.

been found to be satisfactory. A rotation of the auxiliary housing produces a like rotation of the slitimage. The slit width control must be opened to its maximum aperture.

The modification does not alter or affect in any way the normal use of the Goldmann slitlamp. The auxiliary housing is indexed into position in the same fashion as the pinhole, shortened slit, and so forth.

By use of this device for slitlamp gonioscopy, the major objection to this type of examination is eliminated. We are now able to view clearly the horizontal meridians. The ease, speed, and magnification of the slitlamp procedure have not been sacrificed.

The method of examination of the horizontal meridians does not vary. The slit is focused on the mirror in the 9-o'clock position for observation of the 3-o'clock area. It is useful to swing the coupled microscope and illuminating arm nasally to observe the nasal portion and temporally to observe the temporal portion of the angle. The patient may be required to look slightly to the left or to the right as indicated.

The images seen with each eye are slightly dissimilar. Even though the horizontal areas of the angle can be examined in optical section stereopsis may not be possible in all cases with all examiners.

490 Post Street (2).

DEVICE FOR USE IN TEACHING REFRACTION*

R. F. Binder, M.D., and J. R. Skelly, B.A.
Cleveland, Ohio

The device consists of a frame, the front of which is covered by a sheet of Plexiglas. Two dowels are mounted in front of the Plexiglas to indicate the course of rays in the human eye (fig. 1). The focus of these rays may be changed by means of a sliding button. Along the left side of the frame there is a slot which permits the introduction of acetate inserts behind the Plexiglas sheet.

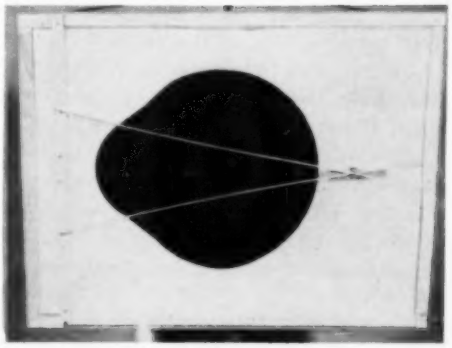

Fig. 1 (Binder and Skelly). Device as used to illustrate hyperopia. By sliding "focus" to the left, emmetropia and myopia may be illustrated.

One of the acetate inserts carries the silhouette of a human eye. When this insert is placed behind the Plexiglas, refractive errors and operations to correct them may be illustrated by changing the "focal length" of the dowels.

The other insert (fig. 2) carries part of the conoid of Sturm. When this insert is placed between the silhouette of the eye and the Plexiglas front, the problems which arise

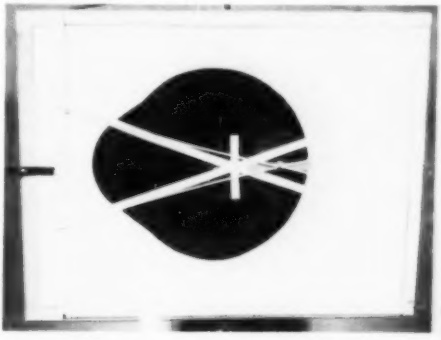

Fig. 2 (Binder and Skelly). Device as used to demonstrate problems in astigmatism. The two meridians indicate the positions of the focal lines. The adjustable meridian on the left edge indicates the axis of the correcting cylinder.

* From Western Reserve University School of Medicine and the Department of Ophthalmology, Division of Surgery, University Hospitals of Cleveland.

in the correction of astigmatism may be demonstrated. The position of the focal lines in the conoid of Sturm may be shown by two adjustable meridians mounted on acetate discs. Operation of the blurring lens (Verhoeff-Lancaster method) may be shown by moving the silhouette of the eye.

Mounted on the left margin of the frame is another acetate disc carrying an adjustable meridian to indicate the axis of the correcting cylinder.

The size of the device used in the lecture room is 20 by 25 inches. A small hand model (6.0 by 12 inches) is used for immediate analysis of refractive problems while working with patients.

2065 Adelbert Road.

PROTECTIVE CORNEAL LENS FOR PROLONGED PROCEDURES*

EARL L. LEWIS, M.D.
New York

In extensive procedures on the eye, such as scleral buckling or vitreous implant, the corneal surface is often considerably traumatized. This impairs the transparency of the cornea and hinders the observations that must be frequently made during the operation.

We have found that a very efficient protective device can be simply constructed by using a plano corneal lens† with 180-degree radius of curvature and a 12-mm. diameter.

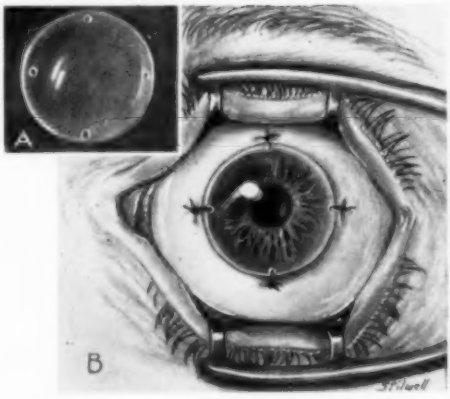

Fig. 1 (Lewis). Protective corneal lens for prolonged procedures.

Tiny holes can easily be drilled in the edges of the four quadrants with a small dental drill, or the lens may be so ordered from the supplier.

The lens is lightly fastened to the limbal sclera with 6-0 silk, thus preventing displacement during the manipulations of surgery. Prior to placing the lens, it is well covered with a sterile wetting agent‡ which allows fluids to adhere to an otherwise waterproof lens.

Excellent unimpeded view of the fundus is afforded with infrequent wetting of the corneal lens surface and the corneal surface is unscathed at the end of the procedure.

210 East 64th Street (21).

* From the Manhattan Eye, Ear, and Throat Hospital.

† Obrig Laboratories, New York.
‡ Obrig wetting agent.

OPHTHALMIC RESEARCH

EDITED BY FRANK W. NEWELL, M.D.

Abstracts of papers presented at the meeting of the Midwestern Section of the Association for Research in Ophthalmology, at Washington University, Saint Louis, Missouri, April 19 and 20 1958.

Prolonged survival induced in the retina of an enucleated eye by drugs. Julia T. Apter, M.D., Northwestern University Department of Ophthalmology, Chicago.

Seven drugs: strychnine, mescaline, lysergic acid diethylamide (LSD), atropine, metrazol, ephedrine and adrenalin were tested for their ability to prolong the survival time of the retina of enucleated eyes of 97 cats.

Strychnine, mescaline, LSD, and atropine were successful in prolonging the survival time if they were given before a dark-adapted eye was enucleated. The normal survival time is four minutes. Strychnine increased this to 40 minutes, mescaline to 25, LSD to 12 and atropine to 12. All doses of the drugs were well below minimal lethal dose.

The ability of the drugs to prolong the viability of the retina paralleled the ability of the drugs to induce spontaneous potentials in the intact eye.

The success of these drugs appears to be independent of circulatory or respiratory effects.

Metrazol, ephedrine and adrenalin had no effect on the viable time of the retina.

These findings suggest that strychnine, mescaline, LSD, and atropine may improve vision or aid recovery in certain retinal diseases. Preliminary observations on one human subject with macular degeneration are described. In this instance small doses of LSD improved central visual acuity and reduced the size of central scotomas over a 48-hour period. Mescaline has previously been shown to have a similar effect on a diseased retina.

Retinal diseases in which the pathophysiology approaches the experimental conditions of the present study include retinal detachment, macular degenerations, and occlusion of the central retinal vein or artery. Studies of the effects of these drugs on retinal diseases are in progress.

An electro-ophthalmographic study of the behavior of the fixation of amblyopic eyes in light and dark-adapted state: A preliminary report. G. K. von Noorden, M.D., and H. M. Burian, M.D., Department of Ophthalmology, College of Medicine, State University of Iowa, Iowa City.

Eyes with strabismic amblyopia do not fixate as steadily as do eyes with standard vision. The fixation movements and saccadic movements of nine patients with squint amblyopia and of two patients with organic amblyopia were studied electro-ophthalmographically in conditions of light and dark adaptation.

While the sound eye assumed fixation with one simple movement, the light-adapted amblyopic eye showed a quite different electro-ophthalmographic response which was characterized by unsteady movements ranging from oscillations and nystagmus to wild, jerky movements.

It appears from this study that there is no definite relationship between the degree of unsteadiness of fixation and the visual acuity; however, it was shown in one case in which the amblyopia was cured by permanent occlusion of the sound eye that the fixation pattern of the amblyopic eye returns to normal with improvement of its acuity.

The most important result of this study concerns the behavior of the fixation pattern of the dark-adapted amblyopic eye. It was found in every instance that after the amblyopic eye had been dark-adapted, the fixation became perfectly steady, the jerky movements disappeared and no obvious difference in fixation pattern between a dark-adapted amblyopic and a normal eye could any longer be demonstrated.

For comparison, two cases with organic amblyopia were recorded electro-ophthalmographically. There was no difference in these patterns whether the eye was light or dark adapted.

This investigation has given direct graphic evidence for the recovery of steady fixation by the dark-adapted amblyopic eye. This may point a way toward an extension of our present treatment of strabismic amblyopia. Macular training in severely restricted illumination after thorough dark adaptation with gradually increasing illumination under constant electro-ophthalmographic control of fixation should be the therapeutic approach making use of the functional improvement of the foveola in dim illumination. Suitable instrumentation permitting such treatment is being tried out at this time.

Experiments with various steroid medications for chronic uveitis. Leo L. Mayer, M.D., Veterans Hospital, and the University of Mississippi Medical School, Jackson, Mississippi.

In 1951, while chief ophthalmologist at the Veterans Hospital in Puerto Rico, I saw cortone being used by the intravenous drip method in rheumatoid arthritic patients over a period of eight hours during the day. Many of these patients had chronic uveitis which lessened in severity after such treatment.

In the Atlanta area of the Veterans Administration, which includes 20 hospitals in the states of Florida, Georgia, South Carolina, North Carolina, Tennessee, and Mississippi, 125 patients with chronic uveitis have been followed for a period of five years.

It is concluded that the best reactions are brought about by using Medrol, (4.0 mg. three times a day) with ACTH (40 units by intramuscular injection twice a day). Since the recent introduction of in-

travenous Meticortelone soluble, a few patients have been given the drug and the rapidity of clearing of the vitreous seems to be enhanced.

Contralateral glare effect on the fusion frequency of flicker. Ernst Simonson, M.D., Department of Ophthalmology, University of Minnesota Medical School, Minneapolis.

In view of the increasing application of the fusion frequency of flicker in physiologic stresses and pathologic conditions, separation of central and retinal components was desriable. The fusion frequency of flicker was measured on the left eye, with a brightness of the test patch of 150 foot-lamberts, visual field of 1.5 degrees, light:dark ratio of 50:50, and surrounding illumination of one foot-candle, before and during glare exposure of the right eye. At this brightness level of the test patch, artificial pupils were not necessary.

Exposure of the right eye to glare produced a statistically significant drop of the fusion frequency of flicker of the left eye in three groups of 30 healthy men, tested at three levels of glare (200, 350, and 500 foot-candles). The effect was maximum at 350 foot-candles, with an average drop of −2.0 c.p.s at an initial level of 37 c.p.s. This is fundamentally different from the direct glare effects which increase with increasing brightness. Similar results were obtained in 52 patients with essential hypertension. The variability was quite large, occasional stimulating effects were noted, and in some of the subjects pronounced depressions approaching maximum changes observed in acute fusion frequency of flicker experiments. There was a statistically significant reverse relationship between the initial fusion frequency of flicker and the glare effect. The contralateral glare effect is due to central interaction, possibly simultaneously in the right and left visual centers.

Ultraviolet luminescence of anterior segment of eye. Lester Stein, M.D., Steubenville, Ohio.

Use of Wood's Light (3650 Å) has presented an optical tool to detect and study a variety of lesions.

Keratoconus, keratopathies, and trauma reveal certain disturbances hitherto unappreciated in white light studies. Color luminography and biomicroscopy permits evaluation of alterations.

In glaucoma the hydration of fluids into the cornea is demonstrable experimentally and luminographs will be presented to demonstrate a variety of phenomena of significance in basic research.

In lens chemistry research, the significance of differential sulfhydryl concentrations between juvenile and senescent crystallines is exemplified by the remarkably different primary luminescences.

Effects of electrical stimulation of the orbital parasympathetic pathway on intraocular pressure. Mansour F. Armaly, M.D., Department of Ophthalmology, State University of Iowa, Iowa City.

Results of experiments on 105 eyes of 56 cats revealed that stimulation of the parasympathetics produced profound changes, short and long lasting, in intraocular pressure, vascular bed, fluid dynamics and chamber angle.

The ciliary ganglion with its pre- and postganglionic trunks was exposed in anaesthetized cats, two to four weeks after bilateral superior cervical sympathectomy. All connections of this pathway to other nerves or muscles were severed. A controlled electric stimulus applied anywhere to this pathway produced only intraocular effects limited to the stimulated side; interruption of this pathway anywhere between the point of stimulation and the globe eliminated these effects.

Continuous simultaneous records of intraocular pressure in each eye and systemic arterial pressure were obtained from pressure transducers appropriately cannulated.

Severing the proximal connection of the preganglionic trunk produced deepening of the central part of the anterior chamber, dilatation of the pupil and a rise in intraocular pressure of 2.0 to 4.0 mm. Hg.

Stimulation of this pathway led to forward bulging of the central part of the lens, reduction in depth of the central portion of the anterior chamber, marked increase in the depth of the chamber angle, constriction of the pupil and reduction in intraocular pressure; pectinate ligament fibers changed position and dimension indicating active pull by the ciliary muscle. No change was observed in the caliber, number or flow of the conjunctival, episcleral, aqueous or retinal vessels.

Pressure reduction was immediate, reached a peak in two seconds, maintained it during stimulation, and recovered the initial level as rapidly after cessation. Failure to recover the initial level occurred when stimulation lasted for 20 to 45 minutes.

Pressure reduction was 4.0 to 10 mm. Hg at pressure of 20 to 25; it varied directly with the initial pressure, reaching 20 mm. Hg at a pressure of 55. Reduction in intraocular volume differed significantly with the pressure level. The response after death or enucleation was a rise of 0.5 to 1.0 mm. Hg irrespective of the pressure level.

The response was not influenced by: severing all extraocular muscles, effective curarization, effective Dibenamine blockade or jugular vein ligation. It was reduced by pilocarpine and adrenalin. Could be eliminated by ligation of the internal carotid, or at pressures of 12 to 15 mm. Hg or by 15 μg. of atropine per kilo intravenously. It was reversed by Diamox, or at pressure levels lower than 10 m. Hg.

Studies of the rate of change of pressure following injections of saline into the anterior chamber without and during stimulation, revealed a significant increase in this rate during stimulation indicating an increase in the facility of outflow during stimulation.

On the depth of focus of the human eye. John T. Schwartz, M.D., and Kenneth N. Ogle, Ph.D., Mayo Clinic and Mayo Foundation, Rochester, Minnesota.

This is a progress report on an experimental

study of the depth of focus of the human eye, determined on the basis of loss of visual acuity as the retinal image becomes blurred due to out-of-focus imagery. A special apparatus was used and the following were kept constant: (1) pupil size; (2) angular size of test target; (3) accommodative state; (4) light-adaptation level; (5) spectral distribution; (6) fixation distance; (7) target exposure time (1/5 second), and (8) target illumination. The effect of changes in each of the first two on the depth of focus was specifically investigated.

The experimental arrangement incorporated the checkerboard as the test target. The probability of the subject's being able to resolve the detail of the test target was determined for different degrees of out-of-focus imagery. The depth of focus was stated in terms of the 50-percent level of probability of visual resolution for a given pupil diameter and for a target of specific angular size. The depth of focus at the 99-percent level of probable resolution was also determined, but these values are less accurate.

The size of the entrance pupil was determined by photographic flash technique. The pupil size was altered by the use of appropriate drugs.

Experimental results on three subjects showed the following:

a. For a test target of size approximately equivalent to Snellen 20/25, and with the subject's normal pupil size, the depths of focus at the 50-percent level were 0.78, 1.04 and 1.00 diopters; at the 99-percent level the depths were 0.45, 0.76 and 0.68 diopters for the three subjects. The normal pupil sizes were 4.8, 3.9 and 5.3 mm., respectively.

b. By varying the target size above equivalent Snellen 20/25 through 20/40, the data suggested a nearly linear increase in depth of focus. Among the three observers, the average rate of increase of the 50-percent depth was about 1.40 diopters per minute increase in visual angle (subtended by individual squares of the checkerboard). The depth of focus for the 99-percent level increased an average of 1.05 diopters per minute increase in visual angle. With target size smaller than 20/25, the depth of focus falls more rapidly.

c. Increasing the pupil size within the range 2.4 and 8.0 mm. gave data which approximated a linear decrease of depth of focus. Again employing the test target size equivalent to Snellen 20/25, the rate of decrease at both the 50-percent and the 99-percent levels was about 0.12 diopter per mm. increase in pupil diameter.

A strain of human lens epithelium: Potentialities for research. P. J. Leinfelder, M. D., and Mona Meltzer, Ph.D., Department of Ophthalmology, State University of Iowa, Iowa City.

Human lens epithelium has been studied in our laboratory during the past two years. Experiments have been made using individual explants from different lenses but this method is unsatisfactory because of the difference in individual sources and because of uncertainty of growth of any explant.

After repeated attempts we have succeeded in obtaining a strain of lens epithelium that has been growing continuously for over six months. This cell strain originated from an explant of lens epithelium from a cataractous lens removed at operation. The cells grow well on glass and readily enter into suspension so that replicate cultures can be made. No particularly characteristic type of cell is observed since some are pyramidal, others are fusiform, and a number are irregular in shape. Active membranes are present on only a few cells, and general cell activity is less than that observed in chick heart fibroblasts. The mitotic time appears to be several times longer than for the chick heart fibroblast.

In order to establish the genetic identity of these cells a study of the chromosome number is being made. Apparently there is an increase in the total number of chromosomes because of splitting of some of the normal ones. Whether there has been a change in the chromosomes as the culture continues to grow and more subcultures are made has not been determined but this should be possible since the original explant was available for chromosome counts.

Now, with a constant source of lens epithelium available, repeated cultures can be done in any number and studies of morphology, differentiation, metabolism, nutrition and genetics can be made. We are particularly interested in the amino acid requirements of the cells, the factors in differentiation of the cells into lens fibers, and the effects of X-irradiation.

Variation of blood and aqueous glucose levels with method of determination. R. G. Janes, Ph.D., H. A. Alert, and W. Lichtenberger, Department of Anatomy, College of Medicine, State University of Iowa, Iowa City. (Supported by Grant B-237 USPHS.)

There is some difference of opinion in the ophthalmic literature concerning the normal glucose ratios of the aqueous humor and plasma. The reported differences may be due to the fact that some animals were anesthetized before the aqueous was withdrawn or because the animals became unduly excited. In the present experiment three strains of rabbits were studied. Blood samples from the marginal ear vein were taken immediately before the aqueous was obtained. Under topical Pontocaine anesthesia aqueous was withdrawn through an anterior chamber puncture. Five micro-methods for glucose determinations were used. In certain instances, two methods of determination were used for portions of the same sample. The glucose ratios for aqueous to blood were as follows: Somogyi, 1.14; Folin-Malmros, 1.10; Hagedon-Jensen, 1.08; Glucostat, 1.30; and by the new Anthrone method, 1.32. This points out that the levels of glucose in the aqueous are higher than those in the plasma in the normal nonfasting rabbit. Furthermore, there is a variation in glucose values depending on the technique used.

Electron microscopy of pigment granules of the retinal pigment epithelium. Y. Taniguchi, M.D., Research Fellow in Ophthalmology, Indiana University Medical Center, Indianapolis. (This study

was supported in part by the Knights Templar Eye Research Fund, Indiana University.)

The retinas of cow eyes were obtained soon after death. The pigment epithelium was detached and divided into three regions: central, equatorial and peripheral. Thin pieces of the epithelium were floated on a watch glass using distilled water, hypotonic sodium chloride, or horse serum. After the pigment epithelial cells burst, the mixture was transferred to a centrifuge tube to allow the pigment granules to separate by settling. With a micropipette, the settled granules were then drawn up and placed on each of a number of grids, some of which were shadowed with platinum. The suspensions were examined after evaporation under the electron microscope with direct magnifications from 1,600 to 20,000 times.

The pigment granules had a number of forms; most of them were cigar shaped with rounded extremities, some were egg shaped or spherical, but a few had a threadlike prolongation. The individual pigment granules varied somewhat in size especially the spherical or egg-shaped ones, and tended to be smaller in the periphery of the retina. The surface of the pigment granules was usually but not always smooth.

No internal structure was recognized within the granules after pretreatment with chloramin-T or buffer solutions but after 80-percent ethyl alcohol the granules are seen to shrivel and microgranules to escape. When sodium chloride solution or horse serum was used for cytolysis, the granules were seen to have a filamentous process at either or both extremities. These filamentous prolongations were several times the length of the pigment granules and usually appeared twisted.

The Moebius syndrome: A case study with electromyography of the extraocular muscles. Maurice W. Van Allen, M.D., and Frederick C. Blodi, M.D., Veterans Administration Hospital and the Departments of Neurology and Ophthalmology, University Hospitals, Iowa City.

The Moebius syndrome (congenital oculofacial paralysis) has been the subject of considerable discussion in regard to its embryologic basis since its description over 75 years ago. Several authors have recently reiterated the opinion of some early observers that the basic defect may be peripheral and in the muscles. They have doubted that the nervous system is primarily involved. The finding of fibrosis of extraocular muscles, check ligaments about the muscles and absence of muscle tissue in biopsies of the face has supported this view. The paucity of autopsy examinations has left the matter open to speculation based on clinical observations.

A 26-year-old white man presented congenital facial diplegia, convergent squint with almost complete absence of eye movement, atrophy of the tongue, club-feet and deformities of one hand. A traumatic cataract was present on the left. Eye movement could not be induced by optico-kinetic stimulation or by caloric stimulation of the vestibules.

Electromyographic studies of both external rectus muscles, the left internal rectus and the right inferior rectus as well as the facial muscles were performed. The external rectus muscles were silent when first encountered by the electrode, but motor unit activity could be induced by electrode movement. Numerous action potentials were obtained from all muscles with waxing and waning of activity in both external rectus muscles, and volleys of potentials resembling the spindles reported in supranuclear lesions. Spontaneously varying levels of activity were also seen in the internal rectus. Simultaneous recording of the left external and internal rectus muscles revealed co-contraction and violation of normal reciprocal innervation patterns. Action potentials from the external rectus muscles were somewhat less numerous than in the normal. A biopsy of the left external rectus revealed essentially normal muscle. The eyes could be passively moved.

Some action potentials were found in the orbicularis oculi. Here, too, electrode movement stimulated prolonged firing of scattered low potential motor units. This activity was found in an immobile area of the face where electrical stimulation did not induce *visible* contraction. Other areas of the face were electrically silent.

The conclusion that a supranuclear lesion in this case is entirely or in large part responsible for the absence of eye movement seems well founded. The facial paralysis may be in part also supranuclear, but extensive nuclear deficiency seemed evident. The presence of gaze paralysis in certain cases of the Moebius syndrome has been noted by many who have studied this condition. The demonstration of a supranuclear lesion provides strong support to the concept that a defect in the nervous system is basic to the Moebius syndrome.

Undoubtedly, variations in severity of supranuclear and nuclear involvement occur in different patients dependent upon the degree and extension of the brain stem lesion whatever the etiology of the syndrome may be. That fibrosis of muscle may be secondary to a developmental nervous system disorder seems quite possible. Perhaps in unusual circumstances, a primary mesodermal defect may give similar extraocular and facial paralyses but these cases would constitute a different syndrome from that under discussion.

Electromyography is of particular value in the study of the Moebius syndrome.

Electroshock therapy and lens opacities. Nathan H. Roth, B.S., and T. F. Schlaegel, Jr., M.D., Department of Ophthalmology, Indiana University School of Medicine, Indianapolis.

Because of Atkinson's observation that subcapsular lens opacities may appear after electric-shock therapy, we decided to study the problem systematically at the Larue Carter Memorial Hospital in Indianapolis. Patients are being studied under maximum mydriasis with the slitlamp before and at

variable periods of time after undergoing electroshock therapy. A meticulous charting of lens opacities both before and after electroshock therapy is being done for comparison purposes. To date a trial group of over 100 patients have been examined in order to perfect our technique and to test our accuracy of observation. To check on the accuracy of our charting we have re-examined 13 of the patients without reference to the initial charting and have found that our recordings are reliable and consistent. The number examined both before and after electroshock therapy is still small and no definite conclusions can be drawn. We have not noticed any clinically important opacities but suspect that we may demonstrate the development of some very minute subcapsular vacuoles.

The effect of sympathectomy on certain electroretinogram functions. G. Peter Arnott, Ph.D., and Mansour Armaly, M.D., Department of Ophthalmology, State University of Iowa, Iowa City.

The process of measurement often results in an alteration of the phenomena being measured. This is particularly true of electroretinography. The level or rate of adaptation can be controlled by employing various flash intensities at various rates. If this means of controlling adaptation is used, electroretinograms can be sampled when desired without introducing an unwanted change in the adaptation level.

In previous work it was found that sudden shifts of the intensity of stimulation produced significant changes in amplitude which would not have been predicted by photochemical theory alone. This study was designed to investigate the effect of sympathectomy on this phenomenon..

Twenty electroretinograms were taken on five New Zealand white rabbits weighing 3.0 to 4.0 kg. A unilateral resection of the superior cervical ganglion was done on the three experimental rabbits. Sham operations were performed on the control rabbits. Each eye of each rabbit was tested on two different days. Seven degrees of light adaptation and stimulation were investigated.

The largest responses were obtained after 10 minutes of total dark adaptation. The mean difference between normal and operated sides was less than 12 microvolts. This is easily attributed to error variance. In some records the normal response was larger, in others the operated. Similar results were noted between the right and left eyes of the control series. No significant differences between the operated and normal eye were observed during the progress of dark adaptation or during the progress of light adaptation. The electroretinographic response to sudden shifts in the intensity of the stimulating light is significantly impaired on the sympathectomized side. This suggests an interference with some regulatory mechanism the nature of which is being investigated.

Epithelium and the anterior chamber: A. Growth of various types of epithelial transplants: B. Wound healing and corneal epithelium. A. C. Hilding, M.D., Research Laboratory, St. Luke's Hospital, Duluth, Minnesota; University of Minnesota Medical School, Minneapolis.

A report in progress describes experimental work on the eyes of dogs and cats with reference to the behavior of epithelium within the anterior chamber and its relation to corneal wound healing. Conjunctival and corneal epithelium, as others have found, do not thrive well in the anterior chamber.

The experiments fall into two groups: (1) The making of surgical corneal openings through which the anterior chamber is accessible for epithelial invasion; (2) the transplanting of various types of epithelium into the anterior chamber.

The following openings were made in the cornea: a series of five parallel incisions made ab externo in the same cornea in a series of five operations so timed as to leave a series of healing wounds of different ages; vertical through and through stab incisions (Saemisch); straight, curved and angled oblique incisions, all of which were left gaping without sutures; curved incisions in which the central lip was made to override the peripheral by means of a mattress suture; simple through and through silk sutures; simple trephine openings; trephine openings with a tongue of iris protruding.

To date there has been no instance of invasion of the anterior chamber from any of the above procedures.

The types of epithelium introduced into the anterior chamber included: scrapings of corneal cells injected by needle; trephine buttons into the same or fellow eye; bits of bulbar conjunctiva and nictitating membrane; frontal sinus mucoperiosteum alone or together with conjunctiva; mucoperiosteum from the bulla of the ear.

Some of these transplants disappeared completely. Others survived but in no instance was the anterior chamber lined. In general, survival seemed to depend upon the establishment of a source of blood supply either from the iris or corneal incision. Some of the transplants grew inverted until epithelium met epithelium and formed cysts. In others, the epithelium was everted covering the outside of the transplant. In these, epithelium could not meet epithelium without growing down the fibrous pedicle and lining the anterior chamber. This has not yet happened. Instead, both the squamous and the respiratory epithelium feather out into a margin of thin, modified cells lying upon fibrous tissue laid down by the aqueous. This margin seems to advance only a short distance from the transplant and ceases to grow.

The corneal stroma was found to heal in the manner described by others.

On the other hand, the endothelium did not heal well and Descemet's membrane regenerated at best in a very rudimentary form and usually not at all. In some instances, the endothelium seemed to cover the fibrous scar tissue in a modified, atrophic form, but often it failed to cover. This may explain the tendency for vitreous to become adherent to cata-

ract incision long after the incisions are supposedly healed.

Electron microscopy and biochemistry of Wallerian degeneration. Sarah A. Luse, M.D., and Richard E. McCaman, M.D., Departments of Pathology and Pharmacology Washington University School of Medicine, St. Louis.

Wallerian degeneration in a peripheral nerve (tibial) and in a central tract (optic nerve) of the rabbit was studied by means of electron miscroscopy and microchemical determinations of lipids and enzymes. The optic nerve was studied 1, 5, 15, 40, 100 and 200 days after enucleation of the eye; and the distal portion of the tibial nerve 1, 5, 15, 40 and 100 days after transection. A small piece of each nerve was fixed in buffered osmic acid for electron microscopy, while the remainder of the nerve was saved for light microscopy or chemical determinations. The tissues for chemical evaluation were frozen in liquid nitrogen, sectioned in a cryostat at −20°C. and lyophylized.

Chemical determinations of lipid content show a marked difference between a degenerating central tract (optic nerve) and degenerating peripheral nerve. In the optic nerve lipid loss was negligible prior to 45 days and only at 100 days was the loss of lipid severe. In peripheral nerve lipid is greatly decreased by 15 days and by 100 days little remains. Electron microscopy corroborated that phagocytosis of lipid detritus occurred later in optic than in tibial nerve.

In optic nerves examined by electron microscopy, degeneration of axons was observed at 15 days following enucleation of the eye. Myelin sheaths were relatively spared, although some were considerably altered. Proliferation of astrocytes, principally fibrous, was evident at 15 days and increased at 45 days. Phagocytosis of degenerating myelin was not demonstrated until 100 days after enucleation and was more marked at 200 days. Occasional evidences of axonal debris were noted within residual myelin sheaths, even at 100 days. Gliosis was marked at both 100 and 200 days. A difference in the rate of removal of myelin in degeneration of a peripheral nerve, tibial, in comparison with a central tract, the optic nerve, was evident. In peripheral nerve, phagocytosis and breakdown of myelin were much faster and little residual evidences of myelin were evident at 100 days.

Scleral rigidity measurements in water provocative tests: Andrew Gay, M.D., Robert Moses, M.D., and Bernard Becker, M.D., Department of Ophthalmology, Washington University School of Medicine, St. Louis.

Utilizing the applanation and the Schiøtz tonometers, scleral rigidity was determined before and after the water provocative test in normal and glaucomatous patients. Preliminary results indicate that some of the tonometric and tonographic changes described after water may be accounted for by changes in scleral rigidity.

Preliminary studies of photic-driving in amblyopic and normal children. James E. Miller, M.D., Jack Hartstein, M.D., George Ullett, M.D., and Laverne Johnson, M.D., Departments of Ophthalmology and Psychiatry, Washington University School of Medicine, St. Louis.

Photic-driving was performed in 10 children with amblyopia ex anopsia and 10 normal children. An electronic analysis of the tracings revealed that children with amblyopia could only be driven when the stimulus was flashed in at a rate below alpha rhythm. No significant difference was noticed between the amblyopic and normal eye. Children without amblyopia responded best in the alpha range.

The hemorrhagic effects of hydro-uterine fluid in mice. Robert A. Moses, M.D. and Marguerite A. Constant, Ph.D., Department of Ophthalmology, Washington University School of Medicine, St. Louis.

In the course of studies of the biologic activity of hydro-uterine fluid produced in mice by ligation of the cervix uteri, Homburger, Tregier and Grossman (Endocrinology, **61**:634, 1957) noted hemorrhagic exophthalmos in some strains of mice. Exophthalmos appeared between 16 hours and four days with a negligible incidence of hemorrhage in other locations in the animal.

BDF_1 mice injected intraperitoneally with 64 mg. (dry weight) showed hemorrhagic exophthalmos. This appeared within 1.5 to 6.0 hours in seven of 28 mice. (Four of these also had hemorrhage elsewhere.) Hemorrhage in other tissues (brain, liver, and so forth) occurred in 14 mice, resulting in a total incidence of hemorrhage in any location of 17 out of 28. Of six heparinized mice only one developed hemorrhage. Intravenous injections of the same preparation either in single or repeated doses failed to produce hemorrhages in nine mice. The hemorrhagic manifestations have also not been produced by intraperitoneal injections of large amounts of typhoid culture filtrate, typhoid vaccine, coli culture filtrate, minced mouse kidney or purified polysaccharide of serratia marcescens.

Corneal transplants and blood types: A clinical study. Parviz Mehri, M.D., and Bernard Becker, M.D., Department of Ophthalmology, Washington University School of Medicine, St. Louis.

The effect of donor-recipient ABO incompatibility on the opacification of the corneal graft comprised the present study. Blood types were obtained on the donors and recipients of corneal transplants. Corneas from O donors were considered compatible with any recipient. Success was determined by clarity of the graft and/or a visual acuity of better than 20/70, with a minimum follow-up period of four months. Failure consisted of opacification of the graft at any time during the follow-up, even if the operation was of benefit to the patient in relieving his symptoms or saving his eye.

The study consisted of 67 corneal grafts, 50 compatible and 17 incompatible. Fifteen of the 50

(30 percent) compatible transplants were successful as compared to seven of the 17 (41 percent) with incompatible blood groups. It may be concluded that compatibility of blood groups of donor and recipient does not appear to be a major factor in opacification of the graft, and that donor-recipient ABO incompatibility is not a deterrent to successful transplantation.

Staining of retinal flat preparations with saccharated iron oxide. Paul A. Cibis, M.D., and Tsuyoshi Yamashita, M.D., Department of Ophthalmology, Washington University School of Medicine, St. Louis.

This presentation gives a general survey of experiments dealing with flat preparations and histologic sections of retinas stained with saccharated iron oxide. The technique employed is described and the results demonstrated by a series of colored photomicrographs illustrating the vascular pattern of the retina in various animals and man.

Mucopolysaccharides in retina. Bernard Wortman, Ph.D., Department of Ophthalmology, Washington University School of Medicine, St. Louis.

On the basis of alcohol solubility and electrophoretic mobility, two forms of acid mucopolysaccharides have been isolated from beef retinas. Physical and chemical characterization of the two forms is in progress.

Aqueous humor secretion: The effects of Pentolinium on normal human eyes. Ahti Tarkkanen, M.D., and Bernard Becker, M.D., Department of Ophthalmology, Washington University School of Medicine, St. Louis.

The effects of Pentolinium (Ansolysen) on aqueous humor dynamics and scleral rigidity were studied by means of tonography and the Goldmann applanation tonometer. Oral administration of 20 mg. of Ansolysen to young, healthy subjects was found to produce no significant changes in intraocular pressure, rate of aqueous flow or scleral rigidity.

Steady-state of tritiated water in anterior and posterior aqueous and vitreous. Seymour B. Goren, B.A., and Frank W. Newell, M.D., Department of Surgery (Ophthalmology), The University of Chicago, Chicago.

Friedman, Newell, LeRoy, and Okita (Am. J. Ophth., **44**:375, 1957) using tritiated water found an average half-life of anterior chamber water to be 7.4 minutes, corresponding to a steady-state turnover rate of 9.4 percent of the volume of the anterior chamber per minute. Earlier, Kinsey, Grant, and Cogan (Arch. Ophth., **27**:242, 1942) used deuterium oxide as a tracer substance, and found the half-life of anterior aqueous water to be 2.7 minutes when measured from anterior chamber to blood and 5.4 minutes when measured from blood to anterior aqueous.

The steady-state rate of exchange of water between the blood, posterior chamber, aqueous humor, and vitreous humor has not been previously reported.

A tracer dose of one millicurie of HTO was injected intramuscularly into male albino rabbits and serial samples of blood were withdrawn from the central artery of the ear. A single paracentesis of the anterior chamber, posterior chamber, or vitreous chamber was performed on each eye at varying intervals after the administration of HTO. Adequate relaxation was obtained so that procedures could be done *without anesthesia*. The results in 190 rabbits were studied. All samples were assayed in a liquid scintillation counter in a toluene system using 2,5 diphenyloxazole (DPO) as the phosphor.

The experimental data were analyzed by numerical integration of a differential equation between limits and by application to the "slope" method. The average rate of turnover of the anterior aqueous humor was found to be 12.2 and 16.3 percent per minute. That of the posterior aqueous was 21.9 and 24.3 percent per minute. The average rate of exchange of HTO of the vitreous humor was 4.2 percent per minute.

The effect of phospholine iodide on aqueous outflow. Gilbert C. Pyle, M.D., and Bernard Becker, M.D., Department of Ophthalmology, Washington University School of Medicine, St. Louis.

The effects of phospholine iodide on tonographic aqueous outflow were studied in normal and glaucomatous human eyes. All of 30 normal eyes showed a facility increase after phospholine iodide. Sixty-five glaucomatous eyes were selected because of unsatisfactory control on other miotics. Repeated tonographic tracings demonstrated on increase in outflow facility of 25 percent or more in two thirds of these eyes, of 50 percent or more in 57 percent and of 100 percent or more in 41 percent.

Rate of aqueous flow: Effects of dichlorphenamide and chlorthiazide in the rabbit. Bernard Becker, M.D., and Marguerite A. Constant, Ph.D., Department of Ophthalmology, Washington University School of Medicine, St. Louis.

The effect of two compounds, dichlorphenamide and chlorthiazide, on aqueous flow as determined by changes in steady state chemistries and by tonography was studied. Both of these compounds were originally claimed to be carbonic anhydrase inhibitors. They were administered intravenously at a dosage of 25 mg./kg., followed by 5.0 mg./kg. intraperitoneally in two hours. (This regimen was found previously to maintain aqueous secretion at approximately 50 percent reduced rate for at least five hours after Neptazane.)

Dichlorphenamide caused a reduction in aqueous flow, calculated from tonographic tracings, of approximately 55 percent and altered aqueous chemistries. Chlorthiazide, a saluretic diuretic later found not to be a carbonic anhydrase inhibitor did not inhibit secretion as determined by either tonography or chemistry changes.

Studies in platelets in relation to diabetic retinopathy. Eugenia Megoussoglou, M.D., Sylvia Moses, M.A., Marguerite A. Constant, Ph.D., and Bernard Becker, M.D., Department of Ophthalmology, Washington University School of Medicine, St. Louis.

A decrease in the saliva digestible fraction of polysaccharides in platelets of diabetics (especially diabetics with retinopathy) compared to normals has been reported (Christini et al.: Ophthalmologica, **133**:119, 1957). These investigators used PAS staining of blood smears fixed either in methyl alcohol or formaldehyde vapor.

In attempting to confirm these observations, the staining quality of platelets and the effects of saliva were found to be influenced by the thickness of the blood smear, the type of fixative used, and the variation in numbers of platelets on a smear.

Using separated platelets resuspended in saline or plasma, formaldehyde vapor proved to be a better preservative of PAS-positive granules but increased their resistance to saliva or diastase treatment. When methyl alcohol was used for fixation, incubation in saline or buffer removed most of the PAS-positive material of platelets even without saliva or diastase. Irregular thickness of plasma coating of smears also altered the resistance of PAS-positive material to treatment. Unfortunately, these variables made it impossible to confirm the finding that the platelets of diabetics with retinopathy were distinctly different from those of other diabetics or normals.

Preliminary assay studies in the minnow of exophthalmos-producing substance. Irvin Pollack, M.D., Marguerite A. Constant, Ph.D., Harry Rosenbaum, M.D., and Bernard Becker, M.D., Department of Ophthalmology, Washington University School of Medicine, St. Louis.

Exophthalmos was consistently produced in Atlantic minnows (Fundulus heteroclitus) following injection of crude anterior pituitary extract or commercial thyroid-stimulating hormone into the coelomic cavity. However, fish receiving multiple injections of sera from a limited series of patients with severe progressive exophthalmos showed no significant increase in intercorneal distance. Preliminary evidence suggested the presence of a substance in these sera which decreased the effective activity of exophthalmos-producing substance in the minnow. Tyroxin or di- or triiodothyronine produced no exophthalmos in the fish, nor did simultaneously injected thyroxin decrease the effects of the anterior pituitary extracts.

Ophthalmic Miniature

She stated that up to within the age of nineteen, the eyes were perfectly natural; although she always had what is termed a full eye, yet there was nothing in her appearance that attracted any peculiar notice; but since then, both herself and friends have noticed a gradual staring, and increasing protrusion of both eyes. The eyes were certainly exceedingly prominent and quite healthy. Having on several occasions witnessed this condition as associated with an enlarged thyroid gland, I at once drew her attention to the neck, when she at once remarked that there had been some prominence at the lower part, which had commenced some three or four years ago, and was gradually becoming larger. She had an enlarged thyroid gland.

Mr. Poland.
Ophth. Hosp. Reports, 1:31, 1857.

SOCIETY PROCEEDINGS

Edited by DONALD J. LYLE, M.D.

CHICAGO OPHTHALMOLOGICAL SOCIETY

October 7, 1957

DR. FRANK W. NEWELL, *President*

SPONTANEOUS INTRAEPITHELIAL CYSTS

DR. MARGARET GERBER presented the case of an 80-year-old white woman who had noted a brown tumorlike mass in the pupil of the right eye. Ten years prior to this examination a diagnosis of glaucoma had been made esewhere but the patient chose to ignore all advice as to therapy and had had no treatment all through this period. On initial examination, a large brown cyst arising from the posterior iris surface occupied three fourths of the pupillary space in the right eye. In the left eye a similar small brown mass was revealed between the 3- and 6-o'clock position by dilating the pupil. The initial tension was 37 mm. Hg, O.U., and this did not change with the instillation of miotics. Mydriasis also seemed to have little effect on the ocular tension. Gonioscopy showed the angles to be closed temporally and open nasally, while tonography showed a slight reduction in coefficient of outflow. This coefficient was unaffected by miotics, mydriatics, and carbonic anhydrase inhibitors. In light of the patient's age, excellent vision (20/20 in each eye), and normal visual fields in spite of a 10-year history of glaucoma, no surgical intervention was advised.

Discussion. DR. DERRICK VAIL: Cysts of the iris, as Dr. Gerber has emphasized, can produce a rather difficult diagnostic problem. The case that Dr. Merz and I described unfortunately was of a student nurse aged 24 years. A very pretty girl who presented this tumorous condition—black tumor, not transilluminating, increasing in size. We watched her for a period of months and months (this was years ago) and since it was getting larger and also, since the ocular tension was increasing, it was felt that delay in enucleation would jeopardize her life. A diagnosis of melanoma was made.

Then, much to my horror, the section showed the cysts of the iris, as Dr. Gerber has brought out. Dr. Reese has presented a very fine paper on this, read before the American Ophthalmological Society, and reference to this will be found in Dr. Gerber's paper. He pointed out that any tumor of the pupil margin that shows these characteristics, presumably should be considered as a cyst first unless proved otherwise.

There were several points in Dr. Gerber's paper that I think are significant in differential diagnosis.

One is that the tumor appears when the pupil is dilated. A solid tumor of the iris in that particular area, I think, must be a great rarity. A melanoma of the posterior part of the iris I believe is rare. So, on the face of it, the chances are in favor of it being a cyst rather than a melanoma.

The second thing is the interesting feature of the fluctuation of the intraocular pressure. The experience that she had with the variation of the intraocular pressure with dilatation of the pupil and the miotic reaction is, I think, also of diagnostic importance. I don't think this has been studied enough and, perhaps, emphasis hasn't been placed on it, but the fluctuation of ocular tensions, whether or not miotics or mydriatics are used, might be of diagnostic importance.

Now the final point I want to bring out is the embryologic development of these cysts. The sinus of von Szily is the space at the pupil where the anterior and posterior part of the posterior iris pigment layer is developed. This is a potential space and persists

for a long time in the embryonic development of the iris, up to and including almost term, and I think probably exists after term. That isn't the type of cyst that we are discussing. The particular cyst under consideration here arises, as the section shows, in the valley of the ciliary processes, where many of the zonular fibers take their origin. As the lens develops and the eye grows, there is a pull on this area by the zonule fibers.

So it is the pull, Dr. Merz and I believe, on this particular area that may lead to these cysts and, of course, as life goes on, these cysts are likely to increase in size.

Now a third thing we must not forget is that lots of times in the embryo, the ciliary processes are on the back of the iris at the angle. As the eye grows, these either migrate backward or perhaps become much smaller, but, it is a thing to bear in mind, from a clinical viewpoint, that such aberrant ciliary processes on the back of the iris, at the angle, may be present. In doing an iridencleisis, for example, perhaps some of the poor results that occur may be due to an aberrant ciliary process. Again, Dr. Reese has pointed this out in a very fine paper prepared a number of years ago. It is more important to know about it if you are doing a trephination because that is the area where a trephination is done and, if there is an aberrant ciliary process, you may do considerable harm. I am very much intrigued with Dr. Gerber's paper and I think it is a fine case report of observation and clinical history, of over 10 years' duration, of a glaucoma that has persisted off and on for this length of time without leading to any glaucomatous changes. I hope she will give us a progress report of this case in about a year or two.

Unusual ophthalmoscopic findings of diagnostic significance

Dr. Harold F. Falls (Ann Arbor) presented many interesting congenital anomalies of the fundus and stressed the importance of examining all available relatives and obtaining a careful prenatal and neonatal history. A third important factor is the realization that many incomplete forms of congenital anomalies exist, one of the most common of which is incomplete albinism.

Photocoagulation of the iris and retina

Dr. James McDonald and Dr. Arthur Light reviewed the history of photocoagulation of ocular tissue with emphasis on the recent work of Meyer-Schwickerath in Germany. They then presented preliminary studies with an apparatus of their own devising. This is essentially a modified microprojector from which the microscope is removed and higher intensity carbons substituted.

In a preliminary set of experiments 24 pigmented rabbit eyes were exposed to this apparatus with the beam focused on the iris. Minimal corneal opacities were produced and all irises showed more or less atrophy of the stroma. In about one third of the irises minute through-and-through perforations were seen. Capsular and subcapsular opacities were produced in the lenses of most of these eyes. An interesting result was the inability to produce iris lesions in albino rabbits in spite of prolonged application times.

A second group of experiments were performed in which the rays were focused on the retina. Lesions were produced in two to three seconds comparable to those depicted by Meyer-Schwickerath. Histologic examination of the iris and retinal lesions showed a destruction of all cellular structure with a tendency toward agglutination of the pigment layers into round balls. The authors emphasized that although their apparatus is not yet ready for clinical application it is an excellent investigative tool at this time.

Discussion. Dr. James E. Lebensohn: McDonald and Light have rendered a service to ophthalmology by their demonstration that photocoagulation of the iris and retina can be effected by utilizing the microprojector after making only some minor and reversible modifications. Even if the Meyer-Schwickerath heliocauter were readily available, the very high cost of the apparatus would be a

limiting factor in its widespread use. However, certain advantages in favor of the heliocauter cannot be denied.

Since the apparatus was perfected in 1950 it has been used successfully by the inventor in a notable number of patients. In 1953 he listed 42 clinical cases; in 1955, 91; and in 1956, 305. This last figure included 58 with macular holes, 92 with peripheral retinal tears and flat detachment, 72 with peripheral retinal degeneration, 37 with retinal holes after previous surgery, 11 barrages for circumscribed detachment, 18 for Eales' disease, and 17 for choroidal tumors and angiomatosis retinae.

His instrument produces a light intensity of 6,000 K. Utilizing the maximum angle of five degrees, the largest coagulation covers an area of 0.5 disc diameter on the retina, but this can be reduced as desired by an adjustable diaphragm. For ophthalmoscopic examination the Compur shutter is set to transmit but two percent of the light; on releasing the shutter, the full intensity of the light takes effect. After the pupil is maximally dilated, the patient lies on the table, a surface anesthetic is instilled and the cornea moistened by isotonic saline.

For the macular area the exposure time is 0.1 to 0.25 second; for peripheral tears and retinal periphlebitis, one to two seconds. An exposure of less than 0.5 second is entirely painless, but with an exposure of two seconds a drawing pain from the heating results. After light coagulation, small intraretinal hemorrhages are frequent, but no hemorrhages into the vitreous have resulted, and no other complication has followed. Histologic examinations show that a firm adhesive chorioretinal scar is produced, that the coagulation extends only to the inner layers of the sclera, that the vitreous and its limiting membrane are not affected, and that no adhesions are formed between the limiting membrane and the coagulated area.

Meyer-Schwickerath states definitely in *Documenta Ophthalmologica*, 1956, that coagulation of the iris over the normal lens leads to a circumscribed subcapsular opacity. He uses light coagulation to produce a new pupillary opening only in aphakic eyes with seclusio pupillae. After the eye is well anesthetized, a glass ring is placed over the limbus by means of which the cornea is kept constantly under water. The exposure time is not over 0.5 second. In 36 eyes so treated, a new pupil was produced immediately in six, and in 14 the coagulation necrosis developed into a hole within a few months. The reaction after coagulation is checked by the use of corticosteroid preparations locally and systemically. As light coagulation cannot be effective unless the tissue is light absorbing or has a light-absorbing tissue immediately posterior, light coagulation is valueless for after-cataract membranes, and in bullous retinal detachments. It is not suitable for retinoblastoma if the lesion is larger than one disc diameter. Xanthelasmas of the lids, however, can be successfully coagulated.

Meyer-Schwickerath emphasizes that the coagulation temperature must be reached in the shortest possible time, within two seconds, as otherwise the heat is diffused away by the blood vessels. When light similar in spectral range to that of the sun (350 to 1,000 millimicrons) is focused on the retina no damage occurs to the cornea from ultraviolet or to the lens from infrared rays.

With the apparatus used by McDonald and Light the area of retinal coagulation is one disc diameter, twice that produced by the heliocauter. The apparatus demands more time for effective coagulation of the iris, three to five seconds, while the heliocauter needs but 0.5 second.

The essayists have proved that with the lens present light coagulation cannot be safely used on the iris. Whether it may be used advantageously in certain types of aphakic glaucoma is another question. Of greater significance than the investigation itself is a by-product thereof—a readily accessible substitute for the heliocauter with which it may be confidently anticipated that further research will duplicate the positive advan-

tages that the heliocauter has demonstrated. Strangely enough, for this we are indebted to Becker's speculative misconception which inspired this study.

David Shoch,
Corresponding Secretary.

MEMPHIS EYE, EAR, NOSE, AND THROAT SOCIETY

Bilateral dendritic ulcers

Dr. Alice R. Deutsch presented Mrs. W. R., aged 43 years, with the history of a mild inflammation of both eyes several years ago, for which she used eyedrops prescribed at that time. In April, 1956, her eyes felt scratchy again. As she did not have her eyedrops she used some milky drops given to her by a friend. Those drops did very well for a few days. For the last week, however, lid swelling and lacrimation occurred and her vision seemed blurred. She had never worn glasses except for reading. Her general health had always been good.

When she was seen for the first time late in April, 1956, she had bilateral edema of the lids, foamy secretion between the lashes and in the lid angle, and a diffuse swelling of the conjunctiva of the lids. The bulbar conjunctiva was also injected. Both corneas showed a fine punctate staining in the center. The preauricular glands were not enlarged. The pupils reacted to light. Fundus examination was impossible because of the severe photophobia. Only epithelial cells and lymphocytes were found in the conjunctival scraping.

A prescription for Chloromycetin drops and aureomycin ointment was given to her. When she returned two days later the right cornea had numerous star-shaped superficial ulcers, and the left cornea was unchanged. At this time the right cornea was denuded, cauterized with tincture of iodine; homatropine, paredrine, and a pressure bandage were applied. The treatment for the left eye was not changed. She was asked to return the next day but did not come back until four days later.

On that day the right cornea did not stain and was clear with exception of a very fine epithelial haze. The left cornea had a large dendritic ulcer, the pupil was narrow, and the iris swollen and hyperemic. The left cornea was denuded, cauterized with tincture of iodine; atropine and a pressure bandage were applied and aureomycin (250 mg., four times daily) was prescribed.

While the right eye returned to normal during the following days, the left eye developed a central disc-shaped opacity in Bowman's zone with recurrent breakdowns of the epithelium in this area. By the end of May the left eye was quiet. A central superficial corneal opacity remained. She reported by mail that she had been well ever since.

Bilateral dendritic keratitis used to be a very rare disease but since World War II more cases of this kind have been observed (Thygeson, P.: Am. J. Ophth., **36**:269, 1953). Dendritic keratitis has developed in patients undergoing systemic and topical cortisone therapy. The question was raised as to whether certain stimuli may call the dormant herpes virus into activity and allow it to be liberated into susceptible tissue. It was also assumed that cortisone might release the virus from the nuclei of the affected cells and spread the infection by disturbing the local immunity (Braley, A. E.: Am. J. Ophth., **35**: 1737, 1952).

The patient presented gave the information that she had never had a fever blister. It is, however, possible that the mild attack of conjunctivitis which she mentioned in her history was an acute herpetic keratoconjunctivitis (though this disease mostly occurs in much younger persons) and that this latent infection was reactivated by cortisone.

This case was reported to demonstrate that it is not only necessary to evaluate carefully the use of cortisone for every case, but that the patient should be warned that this medication is only for himself and should never be given to anybody else.

ACUTE GLAUCOMA AFTER CATARACT EXTRACTION

DR. PHILIP MERIWETHER LEWIS reported an unusual complication after cataract operation.

M. M., a Negress, aged 63 years, had been under observation and treatment since 1943. She was quite myopic, −8.0D., O.D.; −20D., O.S. There was vitreous degeneration and myopic stretching in both eyes, much worse in the left where there was a posterior staphyloma. Best vision was: O.D., 20/70, J4; O.S., counting fingers at two feet.

She was seen every year or two but it was not until 1950 that chronic simple glaucoma was diagnosed. The tension was 34 mm. Hg, O.D., and 46 mm. Hg, O.S. The tension was not permanently controlled well by miotics so a cycloelectrolysis was done on both eyes in 1952. By means of miotics the tension was then controlled and vision and fields maintained until 1955 when, in spite of the regular use of miotics, the tension rose and remained in the upper thirties. Small doses of Diamox controlled this fairly well and was well tolerated. Over the years there was a gradual advance in nuclear cataracts so that vision in her better eye fell to 20/200, J12.

On April 26, 1956, a round-pupil intracapsular cataract extraction, with two peripheral iridotomies, was done without any difficulty. A bubble of air was placed in the anterior chamber and both pilocarpine and eserine were instilled.

Twenty-four hours later the eye was dressed. The lower half of the iris was plastered against the cornea. The bubble occupied the upper half of the anterior chamber where the iris was pushed back so that the upper half of the chamber was deep. The position of the bubble was due to the fact that the patient had spent her entire time with her head and torso elevated on a backrest. The pupil was dilated in spite of two-percent pilocarpine and eserine being used in the operating room. The eye was quite hard. By lowering the head over the side of the bed, the air bubble was made to go to the lower half of the anterior chamber, pushing the iris away from the cornea. The iris remained stuck to the extreme periphery, apparently blocking the angle. Frequent miotics, including DFP four times, were used to try to contract the pupil and draw the iris away from the angle. Diamox (500 mg.) was given at once and 250 mg. every four hours.

Examination eight hours later showed the cornea quite steamy and the eye stony hard. The bubble was back in the upper half of the chamber with the lower half of the iris against the cornea. Vision was reduced to light perception.

The eye was anesthetized and a retrobulbar injection of procaine and adrenalin given. Paracentesis was performed in the lower temporal quadrant and the air let out. Immediately the cornea cleared and the patient said "I can see." The following morning, 48 hours after operation, the eye was again hard, the cornea steamy, and the pupil dilated. However, the anterior chamber had reformed and was fairly deep. Strong miotics and Diamox were continued. The next day the cornea had cleared, the tension was normal, and the patient could see. No further complications occurred and the patient left the hospital on the seventh postoperative day in good condition.

When seen a few days later, the tension was normal and vision was 20/100 without glasses. It was felt that this eye would have been permanently blinded if appropriate treatment had not been promptly instituted. Therefore, this case serves as another bit of evidence in favor of the daily inspection and dressing of all postoperative cataract cases.

Eugene A. Vaccaro,
Recording Secretary.

YALE UNIVERSITY CLINICAL CONFERENCES

January 11 and 25, 1957

DR. R. M. FASANELLA, *presiding*

SURGERY IN CONGENITAL GLAUCOMA

DR. HAROLD G. SCHEIE, professor of ophthalmology, University of Pennsylvania School of Medicine, said that the term congenital glaucoma has been applied to all the cases of primary glaucoma occurring in patients under the age of 35 years, but the disease acts just as any chronic simple glaucoma does. There is no difference between the infantile and juvenile glaucoma in respect to the appearance of the angle. Infantile glaucoma would be that developing from birth up to the age of two or three years, when the eye is still elastic.

The major symptoms of infantile glaucoma are:

1. Photophobia, which in Dr. Scheie's opinion is the most important symptom. He also noted that one third of the cases of infantile glaucoma have symptoms at birth.
2. Enlargement of the globe.
3. Corneal haze, which in the beginning is due to subepithelial fluid collection and later to edema of the stroma and cicatricial opacities.
4. Ruptures of Descemet's membrane.
5. Glaucomatous atrophy of the optic disc, which is considered a poor sign and develops rather late because the eye is elastic.
6. Increased intraocular pressure.

In connection with the measurement of the intraocular pressure in these cases, Dr. Scheie emphasized: (1) General anesthesia with complete relaxation is absolutely imperative; the eyes must not be rotated upward; if the eye is still rotated upward under anesthesia, a tension of 35 to 45 mm. Hg is common and represents a false-positive; (2) endotracheal anesthesia is advised for complete freedom of the airway.

Sources of error in measuring tension were noted as: (1) Incomplete anesthesia; (2) dehydration preoperatively which may give rise to too low a tension; (3) the corneal diameter is not a practical consideration in the measurement of tension in these cases.

The upper limit of normal is considered as 27 mm. Hg (Schiøtz). Dr. Scheie emphasized that a tension taken in the office using a baby bottle for sedation is definitely no good. He observed that he has seen no case which showed progression of the condition if the tension (when properly taken) was under 27 mm. Hg. He would not operate on any child unless tension taken under anesthesia was definitely abnormal.

Dr. Scheie then discussed gonioscopy in infantile glaucoma. He mentioned the palisading that is noted at the iris periphery. He does not believe the iris is attached to Schwalbe's line and cannot see a film over the canal of Schlemm area. He studied 90 eyes in which the canal of Schlemm filled anterior to the iris level by compression of the jugular vein.

Surgery, its techniques, and present status were next discussed. Dr. Scheie noted that the operation of goniotomy was first performed in 1891 by deVincentiis. In 1942 and 1947, Barkan used goniotomy in open-angle and in congenital glaucoma. In cases of congenital glaucoma, this technique has been retained. The operation apparently re-establishes the flow of aqueous to the canal of Schlemm. In 1946, Dr. Scheie did his first goniotomy with satisfactory results and, in 1949, his first goniopuncture.

Concerning the technical details of the operation, Dr. Scheie usually prefers to make the goniopuncture below to preserve the upper part of the eye. Edema of the subconjunctival spaces may be present for three years following operation. Dr. Scheie believes that the goniopuncture works by filtration. Mechanism of action of goniotomy is not know but perhaps it, too, works by filtration through microscopic clefts. The operation is worthless in persons over 30 years of

age. In infants, both goniotomy and goniopuncture can control the pressure. In juveniles, goniotomy is not useful but goniopuncture cures a good percentage of cases. He mentioned a series of 30 juvenile glaucoma patients in which control was achieved in 65 percent by goniopuncture. If an infant is born with buphthalmos, the prognosis for good vision is not favorable. If the condition develops after birth, the prognosis for vision is better. Combined goniotomy and goniopuncture is a good operation. The effect seems to be better than from either goniotomy or goniopuncture alone. Slides and a movie were shown to demonstrate the operative procedures.

In conclusion, Dr. Scheie emphasized two points:

1. The importance of early diagnosis.

2. Great care in recording the ocular tension is necessary to avoid both false-positives and false-negatives.

Discussion. DR. FASANELLA: What would you consider as the upper limit of corneal diameter in considering indications for operation?

DR. SCHEIE: I think you can operate on anybody. However, where the corneal diameter is 14.5 to 16 mm., goniopuncture is the procedure of choice because the very thin walls of the eye make the chance of a functioning canal of Schlemm very slight. The upper limit of the normal corneal diameter is usually considered to be 12 mm.

DR. FASANELLA: Would you discuss immediate complications of the operation.

DR. SCHEIE: Hemorrhage is the chief immediate complication. This should be washed out immediately at operation through the goniopuncture entrance wound. Do not let it accumulate in the anterior chamber. Secondary hemorrhages are most unusual. Infection is rare. Traumatic cataract is possible but rare. In connection with operative technique, Dr. Scheie added that the puncture opening should be small. If too large, it is easily possible for the iris to plug the opening. He does not use a contact lens at operation.

DR. YUDKIN: Do you use any local therapy postoperatively?

DR. SCHEIE: I use prophylactic antibiotics and steroids locally for three days. Miotics are instilled at the time of surgery to prevent prolapse. Usually miotics are also used preoperatively unless there is real doubt of the diagnosis.

DR. GLASS: I noticed in some of your statistics that you reoperated four or five days after an original operation. How long do you usually wait to evaluate the results of an operation?

DR. SCHEIE: We now never reoperate for six to eight weeks after the first operation. A pressure level of 50 mm. Hg is common immediately postoperatively. Both eyes are bandaged for 24 hours.

DR. FREEMAN: I believe that goniotomy is not necessarily a specific type of operation, because the knife may affect a relatively broad region in the eye, whereas a goniopuncture is a relatively specific operation.

DR. SCHEIE: In goniotomy all I know is that I sweep a knife across the trabecular region. I do not know for sure if filtration into the canal of Schlemm is re-established or whether microscopic fistulas are formed, or whether another mechanism is at work.

DR. LITTLE: Are the results usually permanent?

DR. SCHEIE: The number of reoperations after the third month is very small, so far. Our oldest case goes back to 1946, therefore the late results, in another 10 years or so, are as yet unknown.

DR. LOVEKIN: Have you had any case of dislocated lens?

DR. SCHEIE: No. Fortunately the zonule in youngsters is very tough.

DR. FASANELLA: Does tonography help in determining the mechanism of action of these operations?

DR. SCHEIE: The aqueous outflow is reestablished, but that doesn't tell us how.

KERATOPLASTY: REOPERATIONS AND MANAGEMENT OF COMPLICATIONS

DR. R. TOWNLEY PATON, New York, discussed the management of complications in keratoplasty and presented numerous slides of illustrative cases. One slide demonstrated a case of perforating ulcer of the cornea. Dr. Paton noted the technical difficulty of using the trephine in this type of eye. This can be managed by merely outlining the incision with the trephine after which a suture can then be placed in the center of the outlined button and pulled upward and the button then cut away with scissors.

Cases of nodular dystrophy usually show a high percentage of good results. In these cases, the corneal thickness is usually normal and there is a good anterior chamber. In occasional cases of conical cornea, where there is considerable edema or hydrops of the cornea, it may be very difficult to use the trephine. Some of these cases are best done with a square graft.

One case presented was that of a patient with multiple embedded corneal foreign bodies as a result of an explosion. In this type of case, there is always the danger of getting some minute foreign bodies into the anterior chamber.

Dr. Paton noted that in cases with extensive corneal scars, prognosis is doubtful. In cases of Fuchs' dystrophy, better results are achieved if operation is done before vascularization develops. He said that cases of old trachoma do not do well, usually because of too much vascularization and scarring. One may occasionally do a preliminary partial penetrating trephination, which then is left alone for one or two weeks. This helps to evaluate control of vascularization and reaction of the eye.

In discussing the various complications of operation, Dr. Paton mentioned: (1) Failure to remove all of Descemet's membrane; (2) Abscess of the graft.

Some technical points in the operative procedure include:

1. Necessity of keeping the trephine perpendicular to the cornea to avoid lacerating the iris.

2. It is generally better to perforate along the temporal margin because it is easier to get the scissors in the wound in that area.

3. For incarceration of the iris, the usual treatment is to pull out the iris, excise the prolapsed area, and put in a fresh suture.

4. Anterior synechias, if small, can be cut by means of a Wheeler or Ziegler knife. Extensive adhesions must be cut with scissors to avoid tearing the endothelium off the adjacent cornea. Occasionally in such a case it is better to repeat the transplant.

5. In aphakia, one can use a metal ring sutured to the sclera in order to lift up on the eye or a prophylactic spatula can be placed across the anterior chamber before making the trephination.

Dr. Paton then discussed the question of poor donor material as a cause of bad results and recommended that each donor eye be examined with the slitlamp. If the eye is collapsed, one can stiffen the eye with injections of saline and cotton gauze to restore it to a useful consistency. Glaucoma eyes can be used if the cornea is clear. He would not use eyes of patients dying from infectious diseases, such as meningitis, and would not use those from cases of lues, glioma, or sarcoma.

As to the type of sutures to use in the operation, Dr. Paton noted that overlying sutures were much easier to remove than edge-to-edge sutures. He uses a curved plastic guard overlying the central button to help keep it in place. Bullous keratitis of the graft can be temporarily relieved and cleared with hot air, very often with a hair drier. In these cases, a lamellar graft can be repeated. Late clouding of the graft—six months after operation—usually requires reoperation.

Cases of uveitis which develop after the corneal transplantation should be treated just as usual cases of uveitis; the chances are that the graft will remain clear. He noted that two thirds of transplantation cases show keratic precipitates from a low-grade

traumatic cyclitis; this can be easily treated as a usual case of cyclitis. Dr. Paton advised the use of a moist-chamber glass for seven months after operation. It keeps the patient more comfortable and helps to keep the transplant clear. He noted that the transplant is anesthetic for several months, which makes this type of treatment quite advisable.

Discussion. Dr. Freeman: The traditional pathologic section doesn't tell us much about corneal transparency and newer methods will have to be developed to help us with this problem. Basically homografts in other parts of the body do not work. The cornea seems to be the chief exception.

Dr. Wies: In aphakia where some vitreous can be seen in the anterior chamber, would that be a contraindication to operation?

Dr. Paton: No. Control of vitreous loss is difficult but it can be accomplished by the methods previously mentioned.

Dr. Wong: What is your opinion of emergency corneal transplant for chemical accidents and also what is your opinion of the use of steroid therapy in keratoplasty for herpes of the cornea?

Dr. Paton: In connection with emergency transplants, one rarely has eyes available when it is necessary. In connection with herpetic keratitis, the use of topical steroids is considered in some quarters definitely contraindicated and yet we know that, in the early stages, much temporary benefit can occur from the use of topical steroids. In some 20 or 25 cases of herpetic keratitis, we have found cures by using intravenous ACTH in fairly large doses. In general, however, I would agree that topical steroids should not be used in herpes cases.

Question from floor: Have you used corneal transplants for dense blood staining of the cornea?

Dr. Paton: I have in one case and the patient did very well.

Dr. Chang: In connection with beta radiation, I would like to ask: (1) Is preoperative treatment indicated; (2) would you use postoperative treatment right after operation or use steroids first; (3) for treatment of a deep vessel, a lot of radiation is usually necessary and the usual applicator is too large to deliver a concentrated dose without some damage to the rest of the eye; a smaller applicator would seem to me to be definitely more helpful. What do you feel about this problem?

Dr. Paton: Postoperative radiation early after operation is usually dangerous, especially because of the necessary manipulation of the eye. There is danger of bulging of the graft or dislodging it and, therefore, I do not advocate it in the early postoperative period. Secondly, late radiation doesn't do too much good. I believe radiation should be done beforehand, when indicated. I would like to ask how the radiologists here feel about the dangers of possible late bad results from beta-ray therapy.

Dr. Chang: If the beta applicator dosage is checked periodically, we know pretty well that the proper dose will be given. I do not feel concerned with the possible carcinogenic effect from its use in eye cases. In relation to wound healing, a dose of 5,000 r would probably delay wound healing. For destruction of superficial vessels 3,000 rep is generally used. We try to keep the dose below 5,000 rep.

William I. Glass,
Recording Secretary.

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CHANGING CONCEPTS IN RETINAL DETACHMENT SURGERY

Gonin, almost 40 years ago, first postulated and demonstrated the fundamental principles for reattachment of the retina. They were: recognition of retinal holes, surrounding them with a choroidal reaction: and then allowing the retina to come in contact with the treated choroid. When the resultant scar tissue sealed off or isolated the retinal break from the surrounding retina, the patient was usually cured. Clifford Walker, in this country, was one of the pioneers and made a great contribution in instrumentation as well as the surgical application of Gonin's principles. To him we are indebted for the Walker pin and a compact diathermy apparatus. In Europe, Gonin,

Lindner, Weve, and others contributed to our knowledge of this most serious ocular affliction.

For the first 15 years after Gonin's treatise, ophthalmologists were concerned with the modifications of intrascleral diathermy, penetrating diathermy, and methods of evacuating subretinal fluid, as well as methods and charts for localizating the retinal breaks. A few ophthalmologists attempted the more radical procedure of resecting a strip of sclera in order to shorten the eyeball. This operation had first been attempted by Mueller in 1903. For many years, however, the treatment of choice was to surround the hole (or holes) with as much diathermy as possible, evacuate the subretinal fluid from the sites of 20 to 30 penetrating pins, keep the patient in bed for three or four weeks, then pinhole goggles for eight to 12 weeks—and hope that everything was in order!

The cure rate with this regime varied between 50 to 70 percent, depending upon the selection of cases, criteria of success, and the patience and skill of the surgeon. Though the recognition of retinal breaks was for many years heralded as the most important factor, there were many surgeons who were operating on the "geographic" principle—treat all the sclera underlying the detached retina!

With the end of World War II, the ophthalmologists here and abroad could once again devote time to studying this crippling ocular disease. It had been recognized for some time that the causes of failure in retinal detachment surgery were unrecognized retinal breaks and inability to bring the retina in contact with the diathermized choroid. The first factor probably was due to the so-called "pressure" under which many of us work, and also to our unfamiliarity with indirect ophthalmoscopy. There is no question that Schepens deserves full credit for reintroducing and stressing the importance of indirect ophthalmoscopy. To most American ophthalmologists, life was "too darn short" to fool with indirect ophthalmoscopy! With it, and with experience, one undoubtedly could study the vitreous and peripheral retina more completely than with our battery or transformer-operated direct ophthalmoscopes.

The second factor of the retina not coming in contact with the treated choroid was confirmed by improved biomicroscopic methods of examining the vitreous, pathologic studies of the vitreous (especially its role in the production of retinal detachments), and clinical observations. This led to many modifications of the classic diathermy operation for retinal detachment.

The idea that we might be dealing with a shrunken retina, or traction on the retina by a shrunken vitreous, led to the adoption of more radical surgical procedures. Most of these were modifications of the scleral shortening procedures attempted by a few radicals of the previous decade. Their reemployment was prompted by the factors already mentioned, as well as by more satisfactory anesthesia, instrumentation, and prevention of infection (and inflammatory reaction) with antibiotics and the judicious use of steroids.

For several years the scleral resection procedure was used as a secondary or tertiary procedure, when conventional diathermy had failed, or as a primary procedure in those cases where experience had shown that the prognosis with conventional diathermy was very poor. In 1945, Leopold was able to collect 121 cases of scleral resection reported in the literature. A few years later, some 400 cases were reported at one meeting—attesting to the increase in popularity of this procedure.

The increasing acceptance of the scleral resection procedure was based on several factors. One, its success in cases where other methods had failed; secondly, if it were satisfactory as a secondary or tertiary procedure, why not adopt it as a primary procedure, when the operative technique is much easier to perform? Also, it appeared to be a logical procedure in high myopia; aphakia, with the shallow fixed detachments that did

not settle with bedrest; in patients with fixed retinal folds; those with extensive peripheral degeneration; and, finally, in patients with large disinsertions, and so forth.

The classic complete and lamellar scleral resection procedures aimed at reducing the scleral area, as well as reducing the volume of the vitreous chamber. This flattening of the scleral curvature made it easier for the retina to come in contact with the treated choroid. Another advantage of this procedure was that the diathermy applications could be more accurately controlled, since they were being applied to the bare choroid, or a thin sheet of sclera overlying the choroid. One did not have to contend with unknown thicknesses of sclera, which does vary considerably.

The infolding procedures involving polyethylene tubing, plastic sheets, sclera, nylon, or chromic sutures, and so forth, differ from the above in that the volume of the vitreous chamber is more markedly reduced, and, because of the augmented choroidal roll, there is little reduction in the inner surface that must be covered with retina.

One of the complicating factors of the lamellar resection procedure and the outfolding procedures is that the scleral wall may be reduced so much that there may be too much slack in the retina and that it will not come in contact with the treated choroid despite adequate drainage of subretinal fluid.

The advantage of the infolding procedure, incorporating some substance in the area of resection, is that by mechanically forcing the choroid against the retina an adhesive ring may be formed about or posterior to the hole, which will last until a firm scar is formed. With the more permanent type (that is, the complete encircling tube of Schepens, or the girdling suture of Arruga) the volume of the vitreous chamber is greatly reduced, and a more or less permanent new ora is formed in the region of the equator. By reducing the volume of the vitreous chamber, further detachment by vitreous contracture may be avoided, and multiple peripheral breaks—or large holes or disinsertions—may be walled off. The proponents of this procedure also feel that there is less destruction of the sclera with diathermy (since it is applied to the bed of the resection). Also, by mechanically forcing the choroid against the retina, one does not have to wait for delayed absorption of the subretinal fluid, and the patients can ambulate and get about in a matter of days, rather than weeks.

There are some who have become so enthusiastic about this factor that they now have practically abandoned all scleral and intrascleral diathermy. In cases of small holes, with or without detachment, a scleral flap is prepared, diathermy applied to the thin base of sclera, and the choroid invaginated by means of small pieces of tubing buried under the scleral flap.

It must remembered, however, that whenever sclera is resected or outfolded, there always is a reduction in the scleral area, and some infolding component. The extent of the latter will vary considerably as to the type of surgery performed.

Since it is acknowledged that the vitreous plays a dominant role in the production of retinal detachments, it is only natural that attempts should be made to attack the problem with this in mind. Cutler and others have replaced opaque vitreous secondary to hemorrhage with fresh vitreous, but to Shafer must go the credit for arousing interest in the injection of fresh vitreous into the vitreous cavity to force the retina against the choroid. Though the principle seems sound, why did not saline or air, which have been used before, prove as effective? It may be that fresh vitreous has some lytic properties on diseased vitreous, and that vitreous adhesions are broken down. It probably is not as yet ready to be used as a primary procedure, though all who have tried it have undoubtedly had at least one or two remarkable results.

Where do we go from here? "The old order changeth, yielding place to the new." Let us not change too quickly!

No matter what technique is used, one must localize the breaks and close them—or wall them off—with diathermy. The newer techniques are no short cut to success. The preoperative examination may take as long or longer than the actual surgical procedure. There is no such thing as a simple retinal detachment; there are some that are easier than others, but one should not forget that simple diathermy may produce massive vitreous contracture, and that the injudicious use of penetrating pins may lead to the production of new retinal holes. One should also remember that idiopathic retinal detachments are bilateral in 25 to 35 percent of patients. Though our concepts in treating these patients have changed, no new simple treatment or short cuts have been devised. There is no question that the operator should use the procedures he is familiar with and with which he has had some measure of success. The present methods of therapy—with all the fancy infoldings, outfoldings, imbrications, and so forth—may eventually prove too radical. We need to know more about the currents used in producing our choroidal reaction. What frequency and what intensity produce the proper eschar, and do the least trauma to the vitreous Should it be unipolar or bipolar? What is the role of vitreous implantation? Do we have substances that will liquefy the vitreous without disturbing the other components of the posterior chamber? There are a score of problems to be solved!

With the increasing longevity of the population, the problem of retinal detachments will be even more serious. The efforts to thwart the degenerative diseases will undoubtedly be of some value in the treatment of patients with potentially weak retinas. If the patient should require surgical intervention, our treatment should follow accepted and proven surgical principles. The pioneering should be left to those with the clinical material to support or disprove their claims. We must be alert to changing concepts but not so radical as to jeopardize the patients' chances for a successful result.

P. Robb McDonald.

THE CRUISE CONGRESS

The II Pan-American Cruise Congress held on board the *Queen of Bermuda* in February served two purposes which were proposed by the council of the parent association and fulfilled to the complete satisfaction of everyone associated with the meeting. The primary purpose was to conduct a scientific program on current clinical ophthalmology under leisurely circumstances with time and opportunity for free and full discussion of subjects that are of interest to the average practitioners. The scientific program was planned by Dr. James H. Allen whose previous experience in program planning for former cruises was so effective. Speakers for panel discussions were selected for their known familiarity with a given subject and their experience in teaching. The assignments consisted of lectures, workshops, panel discussions, moving pictures, and a wealth of slide demonstrations.

The other planned feature of the cruise was to carry to the ophthalmologists of the Caribbean area our greetings and to extend to them our since appreciation of their accomplishments in their own countries and to assure them of our desire to co-operate with them through the Pan-American Association of Ophthalmology in the development of better clinical practice and medical teaching.

The II Pan-American Cruise Congress was no experiment. The success of the previous cruise congress pointed to the value of holding a scientific assembly under conditions of relaxation impossible in the usual full-dress convention of a few days crowded with committee meetings, exhibits, special engagements, and a minimum of social hours

with the family and friends. Usual stated meetings of national societies are crowded with attractions like a three-ring circus. Attendance is no vacation and there are no outside activities. Everyone is out to get what he can and to give of what he has. There just isn't time to do more than to pick up leads and make contacts that make it possible to continue at home after the start picked up at the meeting.

On board a luxury ship such as the *Queen of Bermuda* with every facility for business and pleasure, there is a feeling of relaxation and leisure that brings out audience participation not seen since microphones and 15-minute papers were adopted as skid runners for planned programs.

Many good ophthalmologists are hesitant to talk before a group on their own experiences in private practice. They are a well-adjusted lot who listen and make thoughtful comments rather than preach a doctrine that is as fuzzy to them as a new science. They have comprehension without having to explain to someone else what it is all about. The professional teacher is at ease for his lectures are backed by hours of thought and repeated classroom demonstrations. Experience in lecturing gives one a great advantage before an audience, the greatest of them is his appreciation of the intelligence of his hearer. He will not talk over their heads nor waste their time with trivialities. However, the question-and-answer period following the lecture brings out the lines of thinking that express the many ramifications and collateral ideas that make up the detail in design and color of the whole picture. Only in the atmosphere of the cruise meeting does one find the complete satisfaction that comes of having fully considered a subject.

At the ports of call in the islands the resident ophthalmologists extended a warm welcome to the cruise members and their friends. They appreciate the privileges of the Pan-American Association and through the contacts with colleagues of the western hemisphere, they have an outlet for their scientific accomplishments. Language no longer is a serious handicap. We have gained a friendly association with millions of our neighbors who share our hopes for a better and safer world.

William L. Benedict.

THE FRIEDENWALD LECTURESHIP

The Friedenwald Lectureship has been established under the auspices of the Association for Research in Ophthalmology as a memorial to Dr. Jonas S. Friedenwald. The first such lecture was given by Dr. John E. Harris at the 1957 meeting of the association. Recently it has been announced that Dr. Bernard Becker will give the Friedenwald Lecture for 1958. It is apparent that the Friedenwald Lecture will become a highlight of the annual session of the Association for Research in Ophthalmology.

Almost immediately after his death, the trustees of the Association for Research in Ophthalmology appointed an ad hoc committee to plan a suitable memorial for Dr. Friedenwald. A number of different means of honoring his memory were considered. The committee thought, considering Dr. Friedenwald's interests and ideals, that an award to encourage and recognize research activity by young investigators would best perpetuate his memory. Rather than serving as an additional award for established investigators, as does the Proctor Medal of the association, emphasis was to be placed on the contributions of those who had received less recognition and whose contributions were current. It was decided that recipients would be invited to present a lecture on any phase of ophthalmic research at the annual meeting of the association; a stipend of $500.00 would be awarded to the recipient.

Almost immediately after the appointment of the committee, a number of Dr. Friedenwald's friends and associates sent contributions to start a Friedenwald Memorial

Fund under the auspices of the same committee. The family of Dr. Friedenwald also contributed most generously to the fund. At no time has there been a public request for contributions. This fund has now been turned over the the trustees of the Association for Research in Ophthalmology as a permanent endowment fund for the Friedenwald Lectureship. Further contributions to the fund are necessary if it is adequately to carry out this function. All those interested in perpetuating the memory of a great ophthalmologist whose contributions are so important to all ophthalmologists are invited and urged to send contributions. They may be sent to the secretary of the Association for Research in Ophthalmology, Dr. Lorand V. Johnson, 10515 Carnegie Avenue, Cleveland 6, Ohio.

Suggestions for possible candidates for the awards would be welcomed by the trustees. These may also be sent to Dr. Johnson.

T. E. Sanders.

WILLIAM ZENTMAYER

It is with sorrow that THE JOURNAL learns of the death on March 18th at his home in Merion Station, Pennsylvania, of William Zentmayer, one of the deans of American ophthalmology. A review of his life will appear in an early issue of THE JOURNAL.

CORRESPONDENCE

THANK YOU

Editor,

American Journal of Ophthalmology:

May I have the privilege of the hospitality of THE JOURNAL for a personal message to many of my friends and colleagues.

On my 60th birthday I received a Birthday Book which is so extraordinary that it is quite out of this world, containing messages from ophthalmological and medical bodies from practically every country in the world, as well as delightful messages from many individuals. To thank the latter individually is a pleasure; to thank the official bodies is easy and an equal pleasure; but to thank everyone from the individual societies who have done me the great personal honour of signing the pages of the book, is an impossible task, for they are numbered in thousands, many of them from America. Words are a very imperfect medium for expressing the thoughts which I feel, and I hope that those who showed me so much kindness will accept my thanks through this letter.

Stewart Duke-Elder.

SURGICAL APPROACH TO FOREIGN BODIES

Editor,

American Journal of Ophthalmology:

In the December, 1957, AMERICAN JOURNAL OF OPHTHALMOLOGY (page 745) is an article, "Surgical approach to foreign bodies," which is so misleading and potentially dangerous that certain statements therein should be challenged as to their authoritativeness.

The authors refer to "pinpoint localization and precise mm. surgery." Precise surgery is impossible under the procedure described in this article. The "pinpoint localization" apparently consists of "two Sweet localizations." Operators experienced in the removal of intraocular foreign bodies know that X-ray localizations cannot approach the accuracy of the Berman foreign body locator, which really pinpoints the location of a foreign body within a mm.

The authors recommend an incision eight mm. from the limbus. Apparently they assume that all foreign bodies are free in the vitreous. If they were, an exact X-ray localization would be quite unnecessary. Actually, foreign bodies which have enough velocity to perforate the sclera usually pass through the vitreous until they meet some more resistant tissue, such as the sclera, choroid, or retina, in which they are commonly imbedded, so that they are seldom free in the vitreous. If the operator attempts to move such a for-

eign body from the position in which it has lodged to an incision eight mm. from the limbus, he is very likely to draw the foreign body sideways through the retina and cause unnecessary damage.

An incision located directly over the position where the foreign body has lodged, as determined by use of the Berman locator, causes minimum amount of damage to the retina and confines the damage to a point where the area can be easily and accurately treated to discourage detachment of the retina. If the foreign body is really free in the vitreous, an incision eight mm. from the limbus in the lower, temporal portion of the eye is, of course, most conveniently located, and is no more traumatizing than if located anywhere else.

The manner of making the incision as described in this article is open to criticism. It is described as "concentric to the limbus."

The incision which was being used by my father, Dr. Elbert S. Sherman, 30 years ago, and which was not necessarily original with him, is easier and less traumatizing. This consists of the placing of a double-armed 4-0 suture in a radial direction, so that the bites of the needles, about two mm. apart, straddle the intended incision. A scratch incision is then made down to the choroid, the length of the incision depending upon the size of the foreign body, which is usually known. The lips of the wound are separated by traction on the ends of the suture, which has been left loose. Immediately after withdrawal of the foreign body, usually with the hand magnet, the area is cauterized in whatever manner the operator chooses, the suture is drawn up and tied. In this way no suturing of the sclera is performed while vitreous is escaping or protruding. (Even though the vitreous has not been entered with the tip of the magnet, and I have never entered the vitreous with the tip of a magnet, vitreous may still escape.)

(Signed) A. Russell Sherman,
Newark, New Jersey.

Reply to Dr. Sherman

Editor,
American Journal of Ophthalmology:

Dr. Sherman, in his comments on our article, has inadvertently overlooked several details. In December, 1957, American Journal of Ophthalmology, we stated:

> Many foreign bodies in the vitreous may be removed through a pars plana approach closest to the particle, using a section six-mm. long, concentric with and eight-mm. behind the limbus.

Struble and Croll, in "Technical refinements in the removal of magnetic foreign bodies from posterior segment of the eye," (American Journal of Ophthalmology, **29**: 151-161. [Feb.] 1946) came to the following conclusions regarding magnetic foreign bodies free in the vitreous.

Steel Fragment	Certain Zone I Distance in mm.
0.25 mm.	3.0
0.50 mm.	6.0
1.00 mm.	11.0
Critical Zone II Distance in mm.	**Failure Zone III Distance in mm.**
3.0 to 7.0	Greater than 7.0
6.0 to 10.0	Greater than 10.0
11.0 to 16.0	Greater than 16.0

By noting in advance the size of the particle from the X-ray film and referring to the table above, one can determine with some degree of accuracy whether an approach over the pars plana will be successful or whether it will be necessary to approach the particle more posteriorly over the choroid. We stressed that the nonpenetrating technique should be followed.

We are at present working with Mr. R. Essling, an engineer, to increase the strength of the hand-magnet so that any intraocular foreign bodies free in the vitreous could readily be extracted by the pars plana approach. Also intraocular foreign bodies embedded in the retina and choroid can be removed more readily with the new experimental hand-magnet through a sclerotomy opening directly over the intraocular foreign body.

Foreign bodies of the choroid and retina should be removed through a sclerotomy opening directly over the particle. Pinpoint localization is essential to prevent grooving and tearing of these structures. Nonpenetrating diathermy barrage should be used around the scleral opening. Accurate or pinpoint localization is the basis of successful removal of magnetic intraocular foreign bodies; therefore, it is the basis of preservation of structure and function of the eye.

Roentgenograms and roentgenographic localization of intraocular foreign bodies are indispensable. They show the presence of most foreign bodies, whether magnetic or not, and they furnish a permanent record that there was a foreign body. They also show its size, shape and general position which are essential for preoperative information.

The X-ray localization by the Sweet, Vogt, or Comberg method should be done by a highly skilled specialist. We are fortunate at our hospital (Grace Hospital, Detroit, Michigan) in having an excellent radiologist who likes to do Sweet localizations and is willing to take the necessary time.

The checking of the primary localization can be accomplished by a method described by Dr. Struble in 1942 as pinpoint localization. The calculated foreign body site is exposed but, before opening the sclera, a small piece of lead is sutured to the eyeball at the chosen position then lateral and posterior-anterior roentgenograms are taken. From the relationship of the foreign body to the check marker, the accuracy of incision on the sclera is determined. The lid marker definitely adds to the accuracy of localization.

The Berman locator gives information as to whether the intraocular foreign body is magnetic and to what degree. The Berman locator is a good method to check X-ray localizations and is an excellent instrument to have in the operating room to recheck localization if the foreign body has moved. Multiple magnetic fragments in the orbit or in the tissue adjacent to the globe may prevent satisfactory use of the instrument. While the Berman locator can be used independently of roentgenogram localizations its value is greater when combined with X-ray films.

The surgical technique used by Dr. A. Russell Sherman and his father is excellent; however, we prefer the surgical approach described in our article.

(Signed) Leo J. Croll,
Maurice Croll,
Detroit, Michigan.

BOOK REVIEWS

SLITLAMP GONIOSCOPY. By George Gorin, M.D., and Adolph Posner, M.D. Baltimore, Maryland, Williams and Wilkins Company, 1957. 164 pages, 67 figures, bibliography, index. Price: $7.00.

Gonioscopy has now become a part of the routine examination of the eye and an essential part of the study of glaucoma patients. So far as I know, the first manual of gonioscopy was that by Archimede Busacca (in French) published in 1945 by Ross Lillo, Brazil. Then followed the well-known American treatise by M. Uribe Troncoso, published by F. A. Davis in 1947. Finally, J. François, in 1948, prepared a manual (in French), "La Gonioscopie," for the Societe Belge d'Ophtalmologie, and published by Fonteyn, Louvain. These treatises all were well prepared and beautifully illustrated.

In recent years, due to the improvement of the gonilens and the slitlamp adjustments, slitlamp gonioscopy is becoming more popular. It is relatively simple to do and is quick to perform, and the newcomer to the field can gain facility in the procedure in a very short time.

Gorin and Posner have given us a well-written and useful manual that adequately covers the subject, especially for the beginner. After chapters that contain the anatomy and embryology of the anterior chamber and the history of gonioscopy, there is a fine

chapter of 10 pages on the technique of slit-lamp gonioscopy. Then come chapters on the goniscopic findings in normal eyes, simple glaucoma, angle-closure glaucoma, special forms of glaucoma, secondary glaucoma, and so on.

The illustrations, mostly in black and white, are particularly good. The book should be in the hands of every ophthalmologist.

Derrick Vail.

THE WAR BLIND IN AMERICAN SOCIAL STRUCTURE. By Alan G. Gowman, Ph.D. New York, The American Foundation for the Blind, 1957. 237 pages. Price: $4.00.

Dr. Gowman's first publication has resulted in a book of profound learning in the field of sociology and without doubt is an important contribution to the understanding of the blind. It is a delightful relief to find this study free from the old mechanistic comparisons of the blind and sighted.

This study concerns the impact blindness has on the disabled individual's human relationship. Throughout there is a concern for the problems surrounding the blind and for the obligations which any individual must assume in effectively mastering his disability. Dr. Gowman has broken through the barrier which has retarded the study of blindness in the past, and has opened the way to approach the dynamic functioning not only of the blind but of all physically handicapped individuals.

The selection of subject material has been influenced by the need to promote a general understanding of the blind through the application of social scientific methods. Dr. Gowman emphasizes how impossible it is to treat the blind and the larger society as discrete conceptual elements, and in discussion to speak of the blind without reference to the social mold in which their lives are cast. He points out that in their dealings with others the war-blind find themselves in a wholly new and different social category, relationships are marred by the imposition of stereotype attitudes and a sheer lack of knowledge concerning the real meaning inherent in blindness.

Any discussion of blindness is likely to be charged with emotion. The complete absence of sentimentality and false emotion is an outstanding feature of this work. The ophthalmologist is daily in contact with the visually handicapped and he will find Dr. Gowman's discussions extremely rewarding.

James N. Greear, Jr.

ISTOPATOLOGIA DEL TRACOMA (Volume I [Text]; Volume II [Atlas].) By G. Scuderi. Turin, Italy, Edizioni Minerva Medica, S.A., Corso Bramante 83-85. Text: 150 pages; Altas: 146 pages with 291 illustrations in black and white and in color. Price: Vol. I, 3,000 Lire; Vol. II, 9,000 Lire.

This complete and well-documented text and atlas on the histopathology of trachoma is a noteworthy contribution to ophthalmic literature. The text, which is the smaller volume, has a preface by G. Favaloro in which he refers to the numerous contributions on trachoma that have come from the School of Catania.

In his histopathologic study, Scuderi considers the subject of trachoma under seven headings, as follows: (1) Morphology of the agent of trachoma; (2) trachoma of the conjunctiva; (3) trachomatous tarsitis; (4) chronic interstitial myositis of the orbicularis, the levator, and the muscle of Müller in active trachoma; (5) corneal trachoma; (6) trachoma of the lacrimal gland and of the lacrimal passages; and (7) rare manifestations of trachoma in evolution.

The atlas admirably complements the text and gives a panoramic photomicrographic picture of the evolution of the disease from its earliest stages through its entire evolution. Of special interest are the illustrations of involvement of the lacrimal gland, the levator and orbicularis muscles, and the

lacrimal passages, about which little has been written elsewhere. The chapter on trachoma of the cornea, well documented by photomicrographs, is complete and includes a welcome discussion of posttrachomatous degenerative lesions.

To sum up, it may be said that the two volumes are well worth study by any ophthalmologist interested in ocular pathology and in external disease of the eye.

Phillips Thygeson.

TRAQUAIR'S CLINICAL PERIMETRY. By G. I. Scott. (With a foreword by N. M. Dott.) London, Henry Kimpton, 1957, seventh edition. 304 pages, 280 illustrations, including five colored plates, bibliography, index. Price: 60 shillings.

The sixth and last edition under the authorship and direction of Dr. Traquair appeared in 1949. His book has been known and cherished by ophthalmologists, neurologists, and neurosurgeons everywhere for the past 30 years. It was bad news for all of us to learn of his death on November 14, 1954, although his friends knew that, during the last five or six years of his life, he had suffered a painful, disabling illness, which did not, however, dull his characteristic interest in the progress of ophthalmology. Particularly, as Norman M. Dott says in his foreword, "Courageously he had his seventh edition in mind; and gave his indications for it to his pupil, colleague, successor, and his constant friend, the editor of the present volume, Professor George I. Scott."

George Scott not only "grew up" under Traquair but also worked under Roenne and is eminently qualified to wear Traquair's mantle. He has done the difficult job of revising this bible of perimetry most skillfully. It is no easy matter to pour new wine into old bottles without losing the sparkle.

Professor Scott has introduced into the text a fuller discussion of applied anatomy of the visual pathway, emphasizes the value of the confrontation test, discusses projection apparatus, added new knowledge of neuropathy, subtracted out-of-date material and has rewritten certain parts of the text, particularly the chapters on glaucoma, affections of the optic nerves, and on the chiasm. Twenty-three new illustrations have been added.

It is good to know that this standard work is in such excellent hands, and we welcome the new editor with heartiness.

Derrick Vail.

THE EFFECT ON BINOCULAR VISION OF VARIATIONS IN THE RELATIVE SIZES AND LEVELS OF ILLUMINATION OF THE OCULAR IMAGES. By H. F. Gillott, M.Sc. London, British Optical Association, 1957. 82 pages, 35 figures, bibliography. Price: $2.50.

The problem of measuring the relative size difference in aniseikonia was not adequately solved until the introduction of the space eikonometer in 1945. The author found this instrument accurate within 0.2 percent. The variations in repeated clinical measurements averaged 0.4 percent for the horizontal measurements and 0.1 percent for the vertical. Aniseikonia could be measured satisfactorily with visual acuities as low as 20/100 monocularly or binocularly. An image size difference up to 0.8 percent was considered within normal limits. Among the emmetropes four percent showed size differences over this amount. In anisometropia of 1.0D. or more, significant size differences were found in 81 percent. Successful orthoptic treatment for improving fusion requires that the size error be corrected. Practically all with size errors of over three percent were in the anisometropic group.

For subjects of average stereoscopic sensitivity, an approximate measurement of size difference in the horizontal meridian can be made by a moving rod apparatus of the Sloan-Altman type, giving care to remove

all empirical clues to depth perception. Experiments indicate that the Pulfrich phenomenon is due to a difference in the relative size of the ocular images as well as to a lag in visual perception.

James E. Lebensohn.

REACTIVE CELLULAR CHANGES IN CORNEA AND RETINA. By Prof. Dr. Hans Pau. Halle, Carl Marhold Verlag, 1957. Paperbound, 111 pages, 100 illustrations. Price: DM 38.65.

This small volume is published as fasc. 13 in Velhagen's series of individual treatises on ophthalmology. In the first part the author discusses cell and tissue regeneration in the cornea. In the second part he concerns himself with the histologic findings associated with retinal tears.

The problem of wound healing in corneal lesions was studied in rabbit eyes. In addition to hematoxylin-eosin and Van Gieson stains, Pau employed Feulgen's method for selective staining of cell nuclei and Stöhr's modification of Gros-Schultze's silver stain.

Pau was able to demonstrate that the fixed corneal corpuscles anastomize with each other by means of cytoplasmic processes. Weak silver stains show that each cell contains five (rarely more or fewer) dark corpuscles. In case of trauma some of the cells elongate and assume a linear appearance which he calls "spear cells" ("Spiesszellen"). The dark chromatin bodies enlarge and divide to form the type of cells that are usually referred to as wandering cells. According to the type and severity of trauma they may assume a leukocytoid, lymphocytoid, histiocytoid, or fibroblastic character.

Further investigations proved that the "pus cells" in keratitis also originate from fixed corneal corpuscles. This may have explained their appearance in areas where newly formed endothelial capillaries had not yet made contact with the circulatory system.

A similar situation seemed to prevail in the corneal epithelium (except for the number of chromatin bodies which varied even more).

Interestingly enough there was strong evidence that the fixed corneal cells may even have participated in the formation of the endothelial cells of newly formed capillaries and the terminal fibers of corneal nerves.

Pau was able to substantiate these contents quite convincingly with a large number of really exciting and beautifully reproduced microphotographs.

In the second part of the book the author arrived at equally surprising conclusions in his investigations of the histologic bases of retinal detachment. His material actually was based on the findings of only two patients with retinal detachment who died shortly after surgery. This small number may seem somewhat limited to allow for such far-reaching conclusions. However, by correlating the histologic findings with specific ophthalmoscopic pictures, he seems to have a rather sound basis for his opinion.

There are two types of degenerative (sclerotic) retinal lesions that predispose to retinal detachment: (1) a deep lesion with rarefication and vicarious heaping of pigment clumps of the pigment layer of the retina, and (2) a more superficial lesion with no or little involvement of the pigment layer but grayish-yellow pigmentation of the inner retinal layers.

Hyalinization or fibrosing of the retina is common to both lesions. The patches adhere rather firmly to the lamina vitrea. However, the surrounding retina is weakened, and it is here where the tears occur.

A weakened retinal area *per se* does not lead to retinal detachment without some simultaneous disturbance of the vitreous. Pau does not share the belief that inflammatory lesions cause an adherence between retina and vitreous. He thinks that the embryonic peripheral hyaloïd vascular system which originates from the disc and takes a course parallel to the retina to reach the

tunica vasculosa lentis at the level of Wieger's ligament undergoes anastomoses with retinal arteries during the fourth month of gestation. During the subsequent course, these vessels become obliterated and form mesenchymal septa that are recognized as folded membranes.

If the vitreous becomes detached in some areas, its constant movements may cause retinal tears at the place of attachment to retinal vessels, especially in sclerotic areas surrounding retinal arteries.

Pau puts forth quite original explanations for the mechanism of the various types of retinal tears, for example, horseshoe tears, hole formations with and without opercula, and so forth. Within the limits of a review it is not possible to present more than this brief outline.

The illustrations are superb. Not only do they show an impeccable technique in the processing of the specimens but also a keen sense of observation and imagination in their interpretation. Highly recommended reading for anybody interested in either one of the two topics in this treatise!

Stefan Van Wien.

LIGHT, COLOUR, AND VISION. By Yves Le Grand. Translated from the French by R. W. G. Hunt, Ph.D., J. W. T. Walsh, M.A., and F. R. W. Hunt, M.A. New York, John Wiley & Sons, 1957. 512 pages, 125 figures, bibliography and index. Price: $11.00.

Le Grand, now professor at the National Museum of Natural History at Paris, composed a three-volume work on physiologic optics while at the Institute of Optics. The second volume, now translated at the solicitation of his British confreres, Prof. W. D. Wright and Dr. W. Stiles, considers the eye as a receptor of radiant energy. The absorption from the media affects only slightly the perception of light and color. The major part of the work is based on experimental data in which the viewpoint of the physicist is consistently maintained. This material, which should be helpful to every investigator in this field, answers such questions as how to calculate the retinal illumination of a corrected ametrope, or how to find the confusion centers of dichromats from the neutral point in their spectrum.

The last part of the work contains a fascinating review of visual physiology that will appeal to the mature ophthalmologist. Historically, the retina was first observed microscopically by von Leeuwenhoek (1674), but the visual cells were not discovered till 1835 by Treviranus. Then Schultze differentiated the rods and cones (1866) and Merkel noted the bipolar cells (1870). The retinal consumption of sugar is noteworthy—four times as much as that of the brain. Most visual problems are still veiled. For instance it is doubtful if a purely photochemical theory can account entirely for the phenomena of dark adaptation. It would seem that important modifications also occur in the nerve connections between retinal receptors.

This is a book written by a physicist primarily for those well grounded in the physical approach.

James E. Lebensohn.

ABSTRACT DEPARTMENT

EDITED BY DR. F. HERBERT HAESSLER

Abstracts are classified under the divisions listed below. It must be remembered that any given paper may belong to several divisions of ophthalmology, although here it is mentioned only in one. Not all of the headings will necessarily be found in any one issue of the Journal.

CLASSIFICATION

1. Anatomy, embryology, and comparative ophthalmology
2. General pathology, bacteriology, immunology
3. Vegetative physiology, biochemistry, pharmacology, toxicology
4. Physiologic optics, refraction, color vision
5. Diagnosis and therapy
6. Ocular motility
7. Conjunctiva, cornea, sclera
8. Uvea, sympathetic disease, aqueous
9. Glaucoma and ocular tension
10. Crystalline lens
11. Retina and vitreous
12. Optic nerve and chiasm
13. Neuro-ophthalmology
14. Eyeball, orbit, sinuses
15. Eyelids, lacrimal apparatus
16. Tumors
17. Injuries
18. Systemic disease and parasites
19. Congenital deformities, heredity
20. Hygiene, sociology, education, and history

1

ANATOMY, EMBRYOLOGY, AND COMPARATIVE OPHTHALMOLOGY

Suzuki, A. **Fine structure of normal human conjunctiva as revealed by electron microscopy in sections. II.** Acta Soc. Ophth. Japan **61**:2254-2258, Nov., 1957.

This is a description of normal controls for an electron microscopic study of the trachoma virus in histologic sections. The fine structure of mitochondria, Golgi-apparatus, endoplasmic reticulum and lipid granules in the epithelial cells of the normal human conjunctiva is described, and there are some representative illustrations. (2 figures, 9 references)

Yukihiko Mitsui.

Szirmai, J. A. and Balazs, E. A. **Studies on the structure of the vitreous body.** A.M.A. Arch. Ophth. **59**:34-48, Jan., 1958.

This third paper on the structure of the vitreous body is concerned with the cellular structure of the vitreous. Special reference is made to the cells of the cortical layer in the adult. The possible functional significance and macrophage character of these cells is discussed. The study was performed on the eyes of animals and man using supravital and fixed preparations. (12 figures, 50 references)

Edward J. Swets.

2

GENERAL PATHOLOGY, BACTERIOLOGY, IMMUNOLOGY

Brand, I. **Ophthalmomycosis.** Szemeszet **94**:112-116, 1957.

In the literature concerned with the classification of the allergic responses of cornea and conjunctiva, ophthalmomycosis has not been mentioned. The author observed, during the sensitization of interdigital mycosis of the feet, an ophthalmomykide forming sterile vescicles in the limbus in the society of a dysidrosiform rash occurring in attacks mainly on the palm. While concerned with the pathologic mechanism of the localization of allergo-ophthalmodermatoses, the author assumes that the site of symptoms is influenced by microtraumata having previously affected the sensitized organ, and by circulatory conditions. The passage of allergens in the neighboring tissues is promoted by the retarded circulation in the loops of the vascular network of the limbus.

Gyula Lugossy.

Kozima, S. **An experimental study of ocular allergy.** Acta Soc. Ophth. Japan **61**:1902-1908, Oct., 1957.

Phosphatids were extracted from the uvea of cattle eyes. These phosphatids (10 mg.) were injected into rabbits intravenously with cattle sera (2 ml.) to sensitize the animals. After four weeks the same combination of antigens was given to the animals intravenously. Then an iritis was brought about with anaphylactic symptoms. Neither the phosphatids nor the sera could cause iritis in sensitized animals when they were used independently. This result suggests that ocular phosphatids have an organ-specificity. However, it cannot be an antigen, but it may be a haptene. (4 figures, 5 tables, 19 references) Yukihiko Mitsui.

Lieb, W. A. and Lerman, S. **Keratoplasty and allergic reaction.** Klin. Monatsbl. f. Augenh. **132**:31-58, 1958.

Experiments were done on rabbits and canine corneas were used for the heterotransplantation. An interlamellar transplantation was most frequently done. The allergic reaction in 101 operations was evaluated. These heterotransplants may remain clear and the severity of the allergic reaction depends on the size of the tissue transplanted. The reaction is also more marked when corneal epithelium is attached to the transplant. The stroma alone produces a much lesser allergic reaction. Deep freezing of the transplant prior to the operation increases the antigenic factor. It was not possible to transfer the antibodies passively, which had been produced by the heterotransplant. (14 figures, 7 tables, 58 references)

Frederick C. Blodi.

Nonaka, M. **Antibiotic sensitivity of eye pathogenic bacteria.** Acta Soc. Ophth. Japan **61**:1861-1876, Oct., 1957.

A number of bacteria were isolated from ocular infections. No strain of Koch-Weeks bacteria and pneumococcus showed a resistance against "sensitive" antibiotics. However, many strains of staphylococcus were resistant to antibiotics; 22 percent of staphylococcus strains were resistant to streptomycin, 5.5 percent to chloramphenicol and 16.5 percent to tetracycline. Of Staphylococcus aureous 87 percent were resistant to penicillin. (8 tables, 80 references)

Yukihiko Mitsui.

Shikano, S. **The Arthus-phenomenon of the cornea.** Acta Soc. Ophth. Japan **61**: 2585-2593, Dec., 1957.

Shikano reports an experimental study of the Arthus-phenomenon induced in the rabbit cornea by horse serum and egg white. He shows that a typical Arthus phenomenon with tissue necrosis can be brought about in such an avascular tissue as cornea and, therefore, he is in disagreement with Rich. (8 figures, 17 references)

Yukihiko Mitsui.

3

VEGETATIVE PHYSIOLOGY, BIOCHEMISTRY, PHARMACOLOGY, TOXICOLOGY

Aoki, Y. **Free and bound water in the cornea in some ocular conditions.** Acta Soc. Ophth. Japan **61**:2410-2414, Dec., 1957.

A measurement of free and bound water of the cornea by Hatschek's chloric cobalt method is reported. Free and bound water is 70.22 and 5.28 percent respectively of the normal human cornea. A slight increase in free water occurs in buphthalmos and secondary glaucoma, and a considerable increase in panophthalmia. The increase caused by panoph thalmia is also demonstrated in rabbits by inducing the condition experimentally. (8 tables, 9 references)

Yakihiko Mitsui.

Borras, A. **The electroretinogram of the dog after repeated stimulation.** Arq. brasil. de oftal. **20**:263-282, 1957.

The author analyzes the electroretinogram of the dog subjected to intermittent luminous stimulation of great intensity. The dog has an excitatory retina having both rods and cones. An electronic photostimulator was used permitting repeated stimuli of variable frequencies without modifying the duration or intensity of the stimulus. One electrode was placed in the cornea adjacent to the pupil and the other on the posterior pole of the globe next to the optic nerve, giving the ERG its greatest voltage. Using short, intense stimuli, two fundamental waves were observed, a negative wave "a," and positive, wave "b." The positive wave "c" and the "off" effect were not registered, probably because the duration of "c" is so great that it surpasses the time constant of amplification, and the short duration of the stimuli tends to reduce it in size or to disappear entirely.

The ERG in this study showed wave "a" to be short, simple and well developed. Wave "b" is of lower voltage, greater duration and often multiple. Increasing the frequency decreases the duration of both "a" and "b" waves. At times, increasing the frequency decreases the amplitude. Stimulation lasting more than one second may be followed by a reduction of wave "a" and modifications of wave "b." The ERG recovers its initial apect at the same frequency within a few seconds. The period of recovery is greater when the period of stimulation of the fusion frequency is greater. (11 figures 11 references) James W. Brennan.

Boyer, H. K., Suran, A. A., Hogan, M. J., Scott, K. G. and McEwen, W. K. **Studies on simulated vitreous hemorrhages.** A.M.A. Arch. Ophth. **59**:232-234, Feb., 1958.

Simulated vitreous hemorrhages were produced in rabbits by injection of homologous blood tagged with radioactive chromium. The authors conclude that diffusion into the surrounding tissues and blood vessels determines the rate at which these materials are removed from the vitreous. (1 graph, 1 table, and 2 references) G. S. Tyner.

Cristiansson, John. **Changes in the vitreous body in scurvy. II. Studies on the aqueous content.** Acta ophth. **35**:420-428, 1957.

The increase in the water content of the vitreous body in guinea pigs with ascorbic acid deficiency, described earlier, has been confirmed by dry weight determinations and by measurements of water absorption by the dry substance. The reduced dry weight is interpreted as an increase in the water content. The increased water absorption by the dry substance explains how the vitreous increases in weight during scurvy. The variations have been correlated with the alteration in the structure of the polysaccharide and the degradation of the gel. (1 figure, 2 tables, 27 references) John J. Stern.

Cristiansson, John. **Changes in the vitreous body in scurvy. III. Studies on electrolytes.** Acta ophth. **35**:429-440, 1957.

The electrolyte contents of the vitreous of guinea pigs with ascorbic acid deficiency have been studied in vivo. The distribution of sodium and orthophosphate ions between blood and aqueous is unaffected by ascorbic acid deficiency. In the vitreous, however, there is a reduced orthoposphate content, which may be associated with a change in the colloidal structure. (2 figure, 5 tables, 22 references) John J. Stern.

De Conciliis, U. **Catalytic activity of ocular tissues and fluids.** Arch. di ottal. **61**:321-340, July-Aug., 1957.

The author reviewed the literature since 1904 and measured the catalase activity of aqueous, vitreous, lens, and retina from various animals. The method exploits the

effect of catalase to release oxygen from peroxide. Fresh material was placed on ice in a thermos container in transit. The tissues were triturated in one to six dilution with normal saline solution. Ten sets of each tissue from each animal were run. The titrimetric method of Bonnichsen was compared with the manometric method of Agner and Tealer using the Warburg apparatus. There was considerable catalase in the retina, less in the lens, and very little in the aqueous and vitreous. The amount was found in descending order in the horse, pig, cow, and sheep. (12 figures, 2 tables) Paul W. Miles.

Dohlman, C-H. and Balazo, E. A. **Carbohydrate-containing protein fractions in the corneal stroma.** Acta ophth. **35**:454-460, 1957.

The bovine corneal stroma contains hexosamine and hexoses which are probably a part of the neutral glycoproteins. (3 tables, 20 references) John J. Stern.

Gemolotto, G. **The influence of lysozyme on speed of epithelization of the cornea.** Arch. di ottal. **61**:293-298, July-Aug., 1957.

The antibiotic properties of lysozyme have been used clinically in the past. It has been suspected that lysozyme also increases the speed of cicatrization. To test this, both eyes of 12 rabbits were given a standard corneal abrasion. One eye was treated with 1-percent lysozyme solution in penicillin, while the other eye received the penicillin alone, in drops every three hours. After 24 hours the lysozyme treated areas were only one-third the size of the control areas. The lysozyme treated abrasions healed in 72 hours compared to 96 hours in eyes without it. (1 figure) Paul W. Miles.

Heer, Giuseppe. **The protein content of the normal aqueous humor.** Rassegna ital. d'ottal. **26**:401-410, Nov.-Dec., 1957.

The purpose of this study was to evaluate the protein content of the aqueous in the eye of normal man, dog, and rabbit by means of the micromethod of Lowry and his coworkers. The quantity of protein present in the normal aqueous has been differently estimated by different workers, largely because of a difference of methods of study. The principal obstacles encountered have been the small amount of fluid available and the low percentage of protein present. The author used the micromethod of Folin and obtained results which he feels are dependable. He discovered a marked difference in percentage of protein in the three different species. The amount is greater in the dog than in man and even more so in the rabbit. The percentage in man varies in different pathologic conditions. (2 figures, 4 tables, 15 references) Eugene M. Blake.

van Heyningen, R. and Pirie, A. **Acid-soluble phosphates in the lens.** Biochem. J. **68**:18-28, Jan., 1958.

About 85 percent of the phosphorus in the acid-soluble phosphate compounds of the lens of the calf and young rabbit have been accounted for. The compounds which have been identified and estimated and which have not previously been found in the lens are phosphorylcholine, glycerylphosphorylcholine, phosphorylethanolamine and glycerylphosphorylethanolamine. Uridine 5′-phosphate, uridine diphosphate and uridine triphosphate are also probably present at fairly high concentrations. In addition, the presence of α-glycerophosphate, adenosine 5′-phosphate, adenosine triphosphate and adenosine diphosphate has been confirmed. The low concentration of hexose phosphate and phosphoglyceric acid in lens extracts is confirmed. (9 tables, 51 references) Authors' summary.

Ito, H. **Experimental arachnoiditis in rabbits by typhoid-paratyphoid vaccine.**

Acta Soc. Ophth. Japan **61**:1909-1935, Oct., 1957.

Vaccination against typhoid sometimes causes an acute retrobulbar optic neuritis. Ito injected typhoid-paratyphoid vaccine into the cisterna magna of rabbits. An injection of one dose or of a dose followed by another one week later caused only a slight change in the optic nerve. However, when the interval was extended to three weeks, a severe optochiasmatic arachnoiditis resulted after the second injection. More severe changes were brought about by the same procedure when animals deficient in vitamin B_1 or vitamin A were used. The effect of vitamin B_1 deficiency was particularly definite. In these cases severe changes in the optic nerve fibers were demonstrated also. (14 figures, 19 tables, 47 references)

Yukihiko Mitsui.

Iwagaki, M. **Fundamental studies of intraocular pressure, II. Role of the vitreous in the swelling of the eyeball.** Acta Soc. Ophth. Japan **61**:2143-2148, Nov., 1957.

When the eyeball of the rabbit was immersed in water, a 10-percent increase of eyeball volume results in two hours. The ocular tension increased. When the vitreous was replaced with 2-percent gelatine or saline solution before the immersion, such an increase in the eyeball volume and ocular tension did not occur. Iwagaki considers the vitreous to have a specific water-binding capacity. (5 figures, 2 tables, 55 references)

Yukihiko Mitsui.

Koide, Y. **Experimental studies on regeneration of rhodopsin. V.** Acta Soc. Ophth. Japan **61**:2139-2142, Nov., 1957.

Such metabolic inhibitors as p-chloromerculibenzoate, NaN_3, phlorizin, 2-4-dinitrophenol, $CuSO_4$, $AnNO_3$, CH_2ICOOH, HCN and NaF, impede the regeneration of rhodopsin. The Na_2AsO_2, which accelerates the glycolysis, benefits the rhodopsin regeneration to some extent. Summarizing the results, Koide opposes Wald's view. (J. gen. physiol. **35**: 797, 1952), who concluded that an energy supply is not required in the regeneration of rhodopsin. Koide considers a supply of metabolic energy to be essential in the rhodopsin regeneration (1 table, 14 references)

Yukihiko Mitsui.

Matsumoto, S. **Pathological changes in the retina, optic nerve and arachnoid of mice by aspidium extract poisoning.** Acta Soc. Ophth. Japan **61**:1973-2005, Oct., 1957.

This is a study of the degeneration of the retina and optic nerve by aspidium extract in mice. The degeneration occurs very much earlier in vitamin B_1 deficient animals than in normal controls. A deficiency in vitamin A has a slight but similar effect. For example, a vacuole degeneration in the optic nerve appears in five days in vitamin B_1 deficient mice, in 10 days in vitamin A deficient animals and in 30 days in normal controls when the aspidium extract is given to them in a dosage of about 1/18 LD_{50}. (20 figures, 27 tables, 37 references)

Yukihiko Mitsui.

Murray, D. B. and Ditzel, J. **Effect of CO_2 on the conjunctival vessels, blood pH, and pCO_2 in young diabetic subjects.** J. Lab. & Cl. Med. **51**:370-380, March, 1958.

Inhalations of 5-percent CO_2 for 30 minutes by young diabetic patients produced venular dilation, slowing of erythrocyte velocity, occasional perivenular edema and arteriolar constriction, average arterial blood pH decreases of 0.089 pH units, average plasma bicarbonate content increases of 1.63 mEq./L. and average arterial pCO_2 increases of 11 mm. Hg. The most marked pCO_2 and pH changes occurred in the diabetic subjects with the

most degeneration of the small blood vessels. (4 figures, 2 tables, 33 references)
Authors' summary.

Okada, S. **Leucomycin in experimental endophthalmitis caused by penicillin resistant staphylococcus.** Acta Soc. Ophth. Japan **61**:2160-2174, Nov., 1957.

Leucomycin, an antibiotic found in Japan, and having an action similar to that of erythromycin, was effective in rabbits in the treatment of experimental endophthalmitis induced by inoculation with a strain of staphylococcus resistant penicillin. A subconjunctival administration of the antibiotic in the dosage of 3 mg. was enough to cure the condition. (21 figures, 8 tables, 17 references)
Yukihiko Mitsui.

Saito, K. **Tissue respiration of the inner and outer layers of the retina.** Acta Soc. Ophth. Japan **61**:2504-2508, Dec., 1957.

The tissue respiration of the rabbit retina is measured by Warburg's method after a ligation of either the retinal artery or the ciliary artery. Ligation of the retinal artery causes only a negligible decrease in retinal respiration while that of the ciliary artery causes a decrease of 50 percent. Saito considers that the outer layer of the retina plays a more important role in tissue respiration than the inner. (3 tables, 19 references) Yukihiko Mitsui.

Scassellati Sforzolini, Guidobaldo. **Salicylate of sodium in experimental ophthalmology.** Rassegna ital. d'ottal. **26**:429-435, Nov.-Dec., 1957.

An intraocular inflammatory process was induced by the introduction of a drop of glycerine into the anterior chamber of the rabbit. An attempt was made to overcome the inflammatory reaction by the injection of a solution of sodium salicylate, into the anterior chamber and intravenously, but without success. On the other hand the use of cortisone in a similar manner brought about a prompt reduction of the inflammatory reaction. (4 graphs, 2 tables, 4 references)
Eugene M. Blake.

Senō, K. **Biochemical studies of heterokeratoplasty.** Acta Soc. Ophth. Japan **61**: 2385-2390, Dec., 1957.

This is a basic study for a transplantation of animal cornea into human eyes. Amino acids in various corneas are analysed by a paper-chromatography. Human and chicken corneas contain greater amount of cystine and cysteine and smaller amount of tyrosine than the corneas of monkeys, dogs, cats and rabbits. In corneas with leucoma there is a decrease in cystine and tyrosine and an increase in glutamic and asparaginic acid. (6 tables, 11 references) Yukihiko Mitsui.

Suda, K. and Hagiwara, T. **Mechanism of light reflex of removed eye.** Acta Soc. Ophth. Japan **61**:1802-1805, Oct., 1957.

The pupils of eyes removed from the frog, rabbit and dog react upon exposure to light. Even the excised iris of the rabbit and frog react upon exposure to light. The duration of the positive light reflex after removal is about two hours, and this duration is the same as that of the contraction of the pupil by eserine. When the aqueous taken from eyes removed after an exposure to light is injected subconjunctivally into living animals, contraction of the pupil results in these animals. The aqueous is supposed to contain acetylcholine-like substances. It is also demonstrated that iris tissue is caused to produce an acetylcholine-like substance by exposure to light. The authors conclude that the light reflex of the pupil in the excised eye is due to an increase in acetylcholine-like substances in the aqueous by the action of light. (5 figures, 2 references) Yukihiko Mitsui.

Yamada, S. **Effect of chondroitin sulfuric acid on alkali burns of the cornea.**

Acta Soc. Ophth. Japan **61**:2338-2345, Nov., 1957.

Rabbit cornea recovers from an alkali burn considerably earlier when chondroitin sulfuric acid is given subconjunctivally every day in doses of 0.2 ml. of one-percent solution. This agent seems to stabilize the collagen of the cornea and to inhibit the cellular infiltration into the cornea. (12 figures, 3 tables, 17 references) Yukihiko Mitsui.

Yamamoto, K. **Concentration of carbon dioxide in blood and aqueous; difference between man and the rabbit.** Acta Soc. Ophth. Japan **61**:2154-2156, Nov., 1957.

The concentration of CO_2 in the aqueous and serum is 31.4 and 20.9 mM/L respectively in rabbits, and 19.0 and 20.7 mM/L respectively in man. The aqueous-blood ratio of CO_2 is, therefore, 0.92 in man, while it is 1.50 in rabbits. Yamamoto considers, therefore, that the theory of Friedenwald and Kinsey on the action of diamox as an antiglaucomatous agent is not applicable to man.

Yukihiko Mitsui.

Yamanaka, H. **A study of myasthenia ocularis, with special reference to the potassium release of the extrinsic eye muscles.** Acta Soc. Ophth. Japan **61**:2241-2248, Nov., 1957.

In this basic study of the pathogenesis of ocular myasthenia, the extrinsic eye muscles of rabbits were immersed in potassium-free Tyrode's solution, and also in portions of this solution to which acetylcholine, vagostigmin or myanesin had been added. Acetylcholine and vagostigmin accelerated the release of potassium ion from muscles, and myanesin did the converse. The role of acetylcholine and potassium ion in the manifestation of ocular myasthenia is discussed on the basis of the data. (2 figures, 3 tables, 59 references) Yukihiko Mitsui.

4

PHYSIOLOGIC OPTICS, REFRACTION, COLOR VISION

Breinen, G. M. **Relationship between accommodation and convergence.** Tr. Am. Acad. Ophth. **61**:375-382, May-June, 1957.

The author discusses the subject theoretically. He uses the classification of Maddox. Proximal, tonic, accommodative, and fusional vergences are defined and discussed briefly. The basic theoretical considerations are presented extensively.

Theodore M. Shapira.

François, J. and Verriest, G. **The acquired dyschromatopsias.** Ann. d'ocul. **190**: 893-939, Dec., 1957.

This is the concluding section of a three-part article. The first two articles appeared in the preceding issues of Ann. d'ocul. The present article continues the investigation of the color sense in a variety of clinical entities. More than 20 such diseases and syndromes are discussed and the results of personal observations recorded. For example, patients with essential night blindness, Oguchi's disease, albinism, essential nystagmus and Marfan's syndrome all showed a normal color sense; in retinitis pigmentosa the authors found a blue-green dyschromatopsia; in juvenile macular degeneration all types of color defects were found, from slight red-green defects to total color blindness. A very complete bibliography makes this series of articles doubly valuable. (9 figures, 232 references)

David Shoch.

Graham, C. H. and Hsai, Yun. **The spectral luminosity curves for a dichromatic eye and a normal eye in the same person.** Natl. Acad. Sc., Proc. **44**:46-49, Jan., 1958.

The authors report a case of unilateral color blindness. (1 figure)

Irwin E. Gaynon.

Kronning, Eric. **Transient myopia following the use of acetazolamide.** Acta ophth. **35**:478-484, 1957.

Two cases of transient myopia caused by diamox are described. The myopia set in a few hours after the previously discontinued treatment was renewed, and the degree of myopia was great, 6.5 D. in one case. In this patient the anterior chamber was very shallow, probably because of displacement of the lens forward. This displacement may be due to a reduced volume of aqueous in the anterior chamber. (2 tables, 7 references)

John J. Stern.

Lijo Pavia, J. **Binocular vision: a new effect.** Rev. oto-neuro-oftal. Sudam. **32**: 111-113, Oct.-Dec., 1957.

The author's new effect in stereopsis consists of placing base-out prisms in front of both eyes. If the patient views a stereogram under such conditions, he will see three images; the central figure of the three will be the one with the stereopic effect. It is to be expected that if the eyes are now moved horizontally or vertically a very slight amount, the stereopsis will disappear but this is not true in actual practice. The author feels that the maintenance of stereopsis under such conditions is due to the marked tolerance of the retina towards correspondence and its association with horizontal and vertical noncorresponding points. (1 figure, 8 references) Walter Mayer.

Ogle, K. and Weil, M. P. **Stereoscopic vision and the duration of the stimulus.** A.M.A. Arch. Ophth. **59**:4-17, Jan., 1958.

Using the author's experimental testing apparatus the following results were obtained from a series of tests designed to determine a definite relationship between exposure time and stereoscopic acuity: stereoscopic acuity is independent of the luminance of the objects seen in depth, stereoscopic acuity rapidly deteriorates with decrease in the exposure time of the test object, and the stereoscopic response is no different whether or not the objects observed are in the same plane as the fixation point. (2 figures, 8 graphs, 2 tables, 27 references) Edward J. Swets.

Schlaegel, T. F., Jr. **Spiral visual fields.** A.M.A. Arch. Ophth. **59**:18-23, Jan., 1958.

A study of 800 unselected eye patients revealed an over-all incidence of spiral visual fields in 2.25 percent of them. The confrontation test is not of diagnostic value. The time of day or the method used do not affect the incidence or form of the fields. Spiral fields are transient and usually change to normal or tubular fields. (1 figure, 5 graphs, 19 references)

Edward J. Swets.

Swan, K. C. **Classification and diagnosis of accommodative esotropia.** Tr. Am. Acad. Ophth. **61**:383-389, May-June, 1957.

The author describes two major types of accommodative esotropia: the more common form and the one with residual esotropia for near. He includes a classification of clinical types of accommodative esotropia. Theodore M. Shapira.

Vörösmarthy, D. **Examination of the accommodation curve by Colenbrander's method.** Szemeszet **94**:171-176, 1957.

The author compared various procedures for measuring accommodation. In his view, Colenbrander's method is the best of them. He measured the range of accommodation of 150 emmetropic persons of various ages and represented the values as a function of age. The function has the following form: $y = e^{-0.04787x+2.7682}$. The values obtained are somewhat different from those of the curve of Donders and Duane. The difference is ascribed to the inefficiency of the earlier methods.

Gyula Lugossy.

Walter, Rudolf. **The clock as a visual acuity test.** Klin. Monatsbl. f. Augenh. **132**:107-108, 1958.

The author believes that the pattern of a clock can be used with advantage when testing visual acuity. (1 figure)

Frederick C. Blodi.

5

DIAGNOSIS AND THERAPY

Berens, C., Brackett, V. and Taylor, E. B. **Diverging exercises while accommodating.** A.M.A. Arch. Ophth. **59**:24-28, Jan., 1958.

Many patients with apparently good amplitude of fusion for a light at 25 cm. are unable to maintain fusion when accommodating for small print. These, usually young, patients are frequently slow readers and manifest an overconvergence particularly when shifting to the next line of print. A simple exercise, using readily available materials, is presented, and two cases are cited to illustrate its practical value.

Edward J. Swets.

Breinin, Goodwin M. **Electromyography—a tool in ocular and neurologic diagnosis.** A.M.A. Arch. Ophth. **59**:177-187, Feb., 1958.

This third of a series of papers on electromyography deals with supranuclear mechanisms under the headings of conjugate deviation, spastic esotropia, divergence paralysis, internuclear palsy, and jaw-winking. The work leads to the conclusion that the extraocular muscles behave in a manner consistent with Sherrington's law. (15 figures, 5 references)

G. S. Tyner.

Capolongo, G. **Some observations on the therapy of diphtheritic eye manifestations with antibiotics.** Arch. di ottal. **61**: 347-352, July-Aug., 1957.

Diphtheritic conjunctivitis or keratitis may exist alone, or may be associated with nose and throat lesions. It is not as common in children as in the adult. In the mild form, there is first fever, then what looks like catarrhal conjunctivitis. Later there is edema of the lids, suppuration, and the superficial pseudomembrane over the tarsal conjunctiva. Later there is a seropurulent discharge, swelling of the preauricular node, pale and violaceous skin color, weakness and malaise. If the pseudomembrane is removed, it reforms in about 12 hours.

The grave form of diphtheria of the eyes has four stages. The first infiltrative stage resembles the mild form. The second stage is exudative. After a few days this regresses with the swelling and redness and the third or detersive stage begins. In this, the necrosis disappears and granulation begins. The final stage is cicatrization, in which the symblepharon develops.

Corneal complications are frequent. After the exudative stage, the epithelium loses its specular reflection, develops punctate opacities, then clouds over. There may be extension into the stroma of the central part while the peripheral part clears. The result is a porcelain leukoma. Hypopion is rare.

Prior to the introduction of antibiotics, antiserum was used locally and internally. Now, a more rapid response can be obtained by adding penicillin both locally and internally in massive doses. Improvement may be expected in 24 hours. Aureomycin inhibits diphtheria better in vitro, but not clinically. The use of cortisone tends to result in greater damage.

Paul W. Miles.

Colombi, Carlo. **A new method of studying binocular vision.** Rassegna ital. d'ottal. **26**:448-455, Nov.-Dec., 1957.

Colombi found the apparatus devised by Brecher to be most useful in the study of binocular vision. He discusses the theories and the data obtained in a careful

study of the binocular function. He describes the instrument used and stresses his belief that a study of the amplitude of fusion is of greater importance than that of the heterophorias. (2 figures, 13 references) Eugene M. Blake.

De Toledo, R. and Berretini, G. L. **Antirheumatics in ophthalmic therapeutics.** Arq. brasil. de oftal. **20**:285-290, 1957.

Drugs used in treating rheumatic disorders have been prescribed for some time for inflammatory conditions of the eye. Recently, a new class of antirheumatic drugs has been introduced—derivatives of pyrazolidine having an analgesic, anti-inflammatory and antirheumatic effect. Butazolidin is one of these and is well known. A newer pyrazolic derivative, Irgapirin, has an increased and prolonged analgesic and antiphlogistic action and seems to be effective in treating several ocular inflammatory disorders. A non-specific suppression of inflammation and exudation has been observed in nongranulomatous uveitis and optic neuritis. It is postulated that these pyrazolic derivatives constrict those capillaries which have dilated pathologically and reduce capillary permeability. There is considerable similarity in the therapeutic effect of these drugs, salicylates and the corticosteroids. They interrupt the allergic cycle which is responsible for the symptoms observed, possibly by the liberation of glycocorticoids, although the exact mechanism is obscure. James W. Brennan.

Sampaolesi, Roberto. **Five-year experience with the fluorescein permeability test.** Arch. oftal. Buenos Aires **32**:271-275, Oct., 1957.

In summing up his considerable experience with the well-known Amsler and Huber fluorescein test, which on the whole is in close agreement with that of other investigators, the author points out a fact, so far unmentioned in the literature, which deserves careful consideration: in the so-called exfoliation of the lens capsule, whether associated or not with cataract formation and glaucoma, or both, there invariably is a markedly increased permeability of the blood-aqueous barrier, the dye reaching a particularly high concentration in the vitreous humor. (1 table, 2 graphs, 30 references) A. Urrets-Zavalia, Jr.

Scheie, H. G. and Williams, N. S. **Comparative studies on anesthetic properties of Primacaine HCl.** A.M.A. Arch. Ophth. **59**:81-87, Jan., 1958.

A new anesthetic, Primacaine HCl, produces excellent anesthesia for ophthalmic surgery. In the experience of the authors it is safe, non-irritating, has a longer duration than procaine, and, because of its different chemical structure, can be used in patients sensitive to procaine. (2 figures, 5 tables, 7 references) Edward J. Swets.

Veirs, E. R. and Davis, C. T. **Fungus infections of the eye and the orbit.** A.M.A. Arch. Ophth. **59**:172-176, Feb., 1958.

Four cases of fungus infection are reported, two of the orbit, and two of the cornea. (4 figures, 3 references) G. S. Tyner.

6

OCULAR MOTILITY

Ambrosio, A. and D'Esposito, M. **The syndrome of Türk-Duane, the clinical contribution of electromyography.** Arch. di ottal. **61**:299-314, July-Aug., 1957.

The syndrome of Türk-Duane consists of a congenital retraction or enophthalmos of an eye on attempted adduction. The cause has been said to be fetal aplasia due to an inflammatory process. It could occur from hemorrhage, ischemia, or from a central lesion. There is absence or aplasia of one or both lateral recti. Super-

numerary or accessory muscles have been described.

In this series of six cases, electromyography from a single motor unit at a high velocity of registration showed an increased activity of the intact rectus muscle and none of its opposing internal rectus. (9 figures) Paul W. Miles.

Koskinen, Kaarina. **Experiments with the use of miotics in convergent strabismus.** Acta ophth. **35**:521-527, 1957.

In 136 unselected cases of convergent strabismus, pilocarpin and DFP were used for an average of one year. In 17 of 31 cases with accommodative strabismus, the patients were permanently cured, not only cosmetically but with fusion and stereopsis. In the partially accommodative group, 11 of 58 patients were cured. Miotics had no effect in the nonaccommodative group. (11 references)

John J. Stern.

Koskinen, K. and Vannas, M. **Strabismus surgery as treatment for ocular torticollis.** Acta ophth. **35**:505-520, 1957.

Ocular torticollis was treated by squint operation in 32 patients; in 10 the condition was caused by paresis of the superior rectus muscle. In all cases a weakening operation was performed on the contralateral inferior oblique muscle with good results. Fourteen cases had a primary paresis of the superior oblique. In four, a good result was obtained by tenotomy of the ipsilateral antagonist, in four by myotomy of the same muscle; other methods used were folding of the superior oblique in one and recession of the contralateral antagonist in three. One advancement of the paralyzed muscle and one recession of the ipsilateral antagonist were performed with good results. In seven cases there was simultaneous paralysis of more than one muscle. Two of three patients with paresis of both superiod oblique muscles had good results by weakening of both inferior oblique muscles. Three patients with paresis of both superior rectus muscles were relieved by weakening of the inferior oblique muscles. Finally, one case was due to paresis of the inferior oblique and inferior rectus muscle of the same eye. It was successfully treated by weakening the contralateral synergists. (9 figures, 18 references) John J. Stern.

Lawson, Lawrence J. **Current management of strabismus in childhood.** J. Pediat. **52**:307-312, March, 1958.

The author makes the pertinent ophthalmologic concepts clear to the pediatrician so that he will know when to refer children to the ophthalmologist and will understand the logic of the recommended therapy. (7 references)

Irwin E. Gaynon.

Urist, Martin J. **The effect of asymmetrical horizontal muscle surgery.** A.M.A. Arch. Ophth. **59**:247-259, Feb., 1958.

161 cases in which asymmetrical muscle surgery was done were studied by prism cover measurements before and after surgery in nine positions of gaze. After surgery the medial rectus muscle, being an adductor, had a greater effect in adduction, and the lateral rectus in abduction. When there was a combined operation on one side, the greatest effect of surgery was in the direction of action of the recessed muscle. (10 figures) G. S. Tyner.

7

CONJUNCTIVA, CORNEA, SCLERA

Alberth, B. **Primary zonular opacity in childhood.** Szemeszet **94**:183-186, 1957.

After a review of the literature the author reports the case of a child, aged seven years, in whom osteoporosis due to tuberculosis of the bones resulted in a zonular opacity of the cornea in both eyes. The vision deteriorated in both eyes to 0.02.

After the abrasion of the cornea, visual acuity increased to 1.0 in the right eye and 0.15 in the left eye.

Gyula Lugossy.

Arrechea, A. and Oyenard, A., Jr. **Primary lipoid degeneration of the cornea.** Arch. oftal. Buenos Aires **32**:259-265, Sept., 1957.

In contradistinction to cases in which a fatty degeneration of the cornea is secondary to inflammation or injury of that membrane, its occurrence in otherwise normal eyes is of extreme rarity. Its occurrence in late adult life, the fact that vascularization is invariably present and the absence of any familial character, serve to differentiate it from the hereditary dystrophies. The disturbance is bilateral and consists of a dense yellowish, adipose infiltration of the whole corneal thickness, and of crystalline deposits in the superficial stromal layers. Vision is more or less impaired, according to whether the central or the marginal areas are involved.

The case of a 59-year-old woman is reported where the malady became manifest during the fifth decade and progressed steadily until both corneas were entirely affected except for a small, approximately round axial zone. Vision was reduced to 4/10 in the right eye, while in the left it was still 10/10. The blood cholesterol was elevated throughought a period of 14 years. (4 figures, 12 references)

A. Urrets-Zavalia, Jr.

Bamert, W. **Treatment of mycotic corneal infections.** Klin. Monatsbl. f. Augenh. **132**:95-98, 1958.

A corneal ulcer, after antibiotic treatment, was infected with a type of mucor. Lamellar grafting gave a complete cure. (2 figures, 9 references)

Frederick C. Blodi.

Burns, R. P., Macnie, J. P., Pfeiffer, R. L. and Locatcher-Khorazo, D. **Unilateral conjunctivitis and canaliculitis due to fusospirochetal infection.** A.M.A. Arch. Ophth. **59**:235-242, Feb., 1958.

Three cases of unilateral conjunctivitis with long-standing canalicular inflammation are described. In one patient the inflammation was the result of infection with both spirochetes and fusiform bacilli; in the other two with fusiform bacilli only. Anaerobic culture methods are described. (11 figures, 2 tables, 25 references)

G. S. Tyner.

Capolongo, G. **Preliminary observations on preventive and therapeutic treatment of phlyctenular keratoconjunctivitis as a manifestation of the infective exanthematous diseases.** Arch. di ottal. **61**:315-320, July-Aug., 1957.

Clinical impressions during ten years experience in an infectious disease hospital were reported. Keratoconjunctivitis occurred fairly commonly in the more severe cases of measles. It was less common in scarlatina, chickenpox, typhus, and pertussis. Because of the time of appearance and response of the keratoconjunctivitis to cortisone, it was believed to be allergic in origin. Good effects were observed within 48 hours. The author suggested the use of topical cortisone in the eye as a prophylactic.

Paul W. Miles.

NEWS ITEMS

EDITED BY DONALD J. LYLE, M.D.
411 Oak Street, Cincinnati 19, Ohio

New items should reach the editor by the 10th of the month. For adequate publicity, notice of postgraduate courses and meetings should be received three months in advance.

DEATHS

Dr. Richard Ormond Leavenworth, St. Paul, Minnesota, died January 29, 1958, aged 67 years.

Dr. Joseph Letelle McCool, Monrovia, California, died February 12, 1958, aged 78 years.

Dr. John Chaney Peterson, Lincoln, Nebraska, died February 13, 1958, aged 55 years.

Dr. Relza Newton Sherman, Bradenton Beach, Florida, died January 16, 1958, aged 70 years.

Dr. William Steinman, Miami, Florida, died February 10, 1958, aged 41 years.

ANNOUNCEMENTS

ORTHOPTIC COURSE

The Ohio State University, Department of Ophthalmology, offers a course for the training of orthoptic technicians. Any woman over 20 years of age who has successfully completed two years of college is qualified to apply. Graduate nurses are especially welcome. Candidates must enjoy working with children and meeting the general public.

The course consists of 12 months' didactic and practical training. We are confident that, as didactic lectures are given throughout the year, going hand-in-hand with practical training, this is one of the most comprehensive courses being given in this country. Lectures on refraction, optics, perimetry, general and ocular physiology, anatomy of the brain and orbit, and motility, are given by members of the staff and the Ohio State University Medical School. The orthoptic training is conducted by two orthoptists, and students divide their time between the University Hospital Orthoptic clinic and that at Children's Hospital.

The course starts in September, and students are eligible to take the board examinations for certification given by the American Orthoptic Council.

Limited financial assistance may be obtained from the Delta Gamma Sorority.

Applications for enrollment and additional information may be obtained from:

Department of Ophthalmology
Starling Loving Building
Columbus, Ohio.

BIBLIOGRAPHY

The 1958 volume of the *Bibliography of Medical Reviews* is arranged by subject with a separate author index and contain approximately 2,900 references to review articles in clinical and experimental medicine and allied fields which have appeared largely in 1957. Copies of Volume 3 for 1958 will be available from the Superintendent of Documents, U. S. Government Printing Office, Washington 25, D.C., at a price presently estimated at $1.25.

OPHTHALMOLOGY RESEARCH FELLOWSHIP

An annual research fellowship has been established for the Department of Ophthalmology of The Washington Hospital Center, Washington, D.C. (formerly The Episcopal Eye, Ear, and Throat Hospital). Studies will include clinical work in the corneal clinic, keratoplasty, and animal experimentation. A stipend of $4,800.00 per year, without meals or maintenance, is offered. Requirements are at least two years residency in ophthalmology. Application forms may be obtained by writing to the:

Chairman
Ocular Research Committee
Washington Hospital Center
Washington 1, D.C.

EYE SURGERY IN PAKISTAN

The Sir Henry Holland Mission Hospital in Pakistan announces its annual course in eye surgery to be held from January 1, 1959, to March 15, 1959. During this time intensive eye surgery is done and about 2,000 eye operations are completed. Enrollment may be for four to six weeks and is limited to a few so that maximum benefit may be obtained by the individual.

For further information write to:

Ronald Holland, M.B., F.R.C.S.
Mission Hospital
Quetta, Baluchistan
West Pakistan

ORTHOPTIC EXAMINATIONS

The annual examination of orthoptic technicians by the American Orthoptic Council will be conducted in August and October, 1958.

The written examination will be nonassembled and will take place on Thursday, August 21st, in certain assigned cities and will be proctored by designated ophthalmologists.

The oral and practical examinations will be Saturday, October 11th, in Chicago just preceding the meeting of the American Academy of Ophthalmology and Otolaryngology.

Application for examination will be received by the office of the chairman of examinations:

Dr. Frank D. Costenbader
1605 22nd Street, N.W.
Washington 8, D.C.

Applications, which must be accompanied by the examination fee of $30.00, will not be accepted after July 1, 1958.

Miscellaneous

International lighting vocabulary

A new international vocabulary of lighting terms, the culmination of 20 years of study by a working party of the Commission Internationale del'Eclairage, is now ready for distribution through the organization's United States National Committee.

Printed in three languages—French, English, and German—the vocabulary was created for the express purpose of facilitating communication between scientists the world over who are working in the field of illumination.

The publication, entitled *International Lighting Vocabulary of the International Commission on Illumination* (Volume 1, 2nd Edition) contains 530 terms, with definitions, as well as numerous symbols and formulas.

Its principal sections cover radiation, photometry, colorimetry, eye and vision, production of light, lamps, auxiliary apparatus, lighting techniques, lighting fittings, and light signals.

Volume 2 of the vocabulary will be published in 1959. It will contain the same terms, without definitions, and will be printed in 10 languages—French, English, German, Danish, Dutch, Italian, Polish, Russian, Spanish, and Swedish. The material will be arranged systematically, with 10 alphabetical indexes.

The United States National Committee has placed a prepublication order for the first volume and is offering it at a reduced price. A limited number of copies are now available at $2.50. It is expected that the price will be raised when the initial supply is exhausted.

Orders for the publication with remittances payable to "U. S. National Committee, C.I.E." should be sent to:

Mr. T. D. Wakefield, Treasurer
U.S.N.C.
Vermilion, Ohio.

Societies

Pacific Coast Oto-Ophthalmological

The 42nd annual meeting of the Pacific Coast Oto-Ophthalmological Society was held at the Hotel Vancouver, Vancouver, British Columbia, from Sunday, May 11th, through Thursday, May 15th. Instruction courses on the ophthalmology program included:

"The present status of retinal detachment operations," Dohrmann K. Pischel; "Intraocular tumors," James N. Greear, Jr.; "Choice of operation in primary glaucoma," Orwyn H. Ellis, moderator, Michel Loutfallah and Robert N. Shaffer; "Pathogenesis of intraocular surgical complications," Leonard Christensen; "Surgical procedures of the eyelids," John Phil Keizer; "Strabismus: Diagnostic procedures and selection of operation," Robert C. Laughlin.

Massachusetts alumni meeting

The program for the annual meeting of the Massachusetts Eye and Ear Alumni Association, recently held in Boston, included:

"Blue sclerotics syndrome simulating congenital glaucoma," Donald P. Tucker; "Adenocarcinoma of the meibomian glands: Pseudochalazion phenomenon," Edward C. Sweebe; "Aspherical objective lenses as an aid in indirect ophthalmoscopy," R. David Sudarsky; "One- to two-year follow-up on iridencleisis and cyclodialysis utilizing gel film," David S. Johnson; "An unusual case: One year later," Garrett L. Sullivan; "Lens-induced uveitis in glaucoma," Paul A. Chandler; "Optic atrophy following cataract extraction," Frank D. Carroll; "The present concept of the structure and function of the vitreous body," Endre A. Balazs.

"A modified Friedenwald-Guyton ptosis suture," Brendan D. Leahey; "Studies on the trabecular meshwork," W. Morton Grant; "Some mistakes in ophthalmology," Edwin B. Dunphy; "Rhabdomyosarcoma of the orbit in two brothers," Virgil G. Casten; "Some unusual features of lens metabolism," Jin H. Kinoshita; "Ocular changes in experimental hypercholesteremia," David G. Cogan and Toichiro Kuwabara; "Present status of the plastic cornea in animals," William Stone, Jr.; "Leptothrix and cat-scratch fever," Taylor R. Smith.

"Fitting postenucleation sockets and making plastic prostheses," William Stone, Jr., and Raymond Jahrling: "Developmental and hereditary anomalies of the eye," David D. Donaldson; "Clinical experience with a new miotic: Phospholine iodide," R. C. Lawlor and Pei-Fei Lee; "An aid to the aging myope," Bertha Offenbach; "Gliomas of the optic pathways," Donald D. Matson; "Demonstration of a new stereoscopic device," Frederick H. Verhoeff; "Vitreous loss in the immediate stage: Management" Rocko M. Fasanella; "Researches into the regional distribution of eye diseases," Prof. Ida Mann.

Mr. Charles Snyder, librarian, Howe Library of Ophthalmology, presented an exhibition of early ophthalmic journals. The instruction courses included one on gonioscopy under Pei-Fei Lee and one on histochemistry of the eye under David G. Cogan and Toichiro Kuwabara. The annual Howe Lecture was presented by Prof. Ida Mann, University of Oxford. Her subject was "The application of embryology to clinical ophthalmology."

French Ophthalmological Society

The 65th congress of the French Ophthalmological Society was held in Paris, May 11th through 15th. On the program were:

"Comparative value of electroretinographic curves and of adaptometry in the glaucoma," Bessiere, Chabot, Dutertre, and Mirande, Bordeaux; "The bulbar pressure test in glaucoma," M. Keiu

Suda, Kumamoto; "Tonography of long duration," Ourguad, Etienne, and Volla, Marseille; "Glaucomatous loss of sensitivity," Sedan and Mohamed Aouchiche, Marseille; "Present status of orthoptics and surgery in the treatment of strabismus," Lavat and Canque, Paris; "Inversion of the limits of the visual field: Index of stimulation," Kluyskens, Ghent; "Edemas of stasis of unknown cause," Rougier, Wertheimer, and Wertheimer, Lyon; "Achromatic thresholds of foveal vision in multiple sclerosis," Zanen and Meunier, Brussels.

"Tumors of the conjunctiva," Nordmann, Strasbourg; "Clinico-anatomic observations on tumors of the conjunctiva," Mawas, Paris; "X-ray treatment of epitheliomas of the bulbar conjunctiva," Baclesse and Dollfus, Paris; "Treatment of a neuro-carcinoma of the conjunctiva," Vitte and Chardot, Nancy; "A case of malignant lupo-visceritis of the conjunctiva," Offret and Lombard, Paris; "Difficulties of diagnostic etiology in the oculoglandular syndrome," Cordier and Algan, Nancy.

"The association of vernal catarrh and keratoconus," Bietti and Ferraboschi, Rome; "On the presence of herpes virus in the aqueous in a case of perheptic keratitis," Postic and Jelesic, Novi Sad; "The tonsil: Unappreciated and frequent cause of different ocular affections," Legrand and Baron, Nantes; "Note on the treatment of the diabetic eye with hypoglycemic sulfonamides," Viallefont, Boudet, and Boulad, Montpellier:

Dejean, Leplat, and Hervouet presented the oral report of the society on "The embryology of the eye and its teratology"; Collier, Paul, "Double papillae"; O'Rahilly and Meyer, Detroit, "Embryologic study on the chick's eye." During the discussion and presentation of films, Bonnet, Lyon, presented "The life of the eye in the organism"; Bessiere, Bordeaux, "The sclerectomy of Lagrange"; and Payrau, Raynaud, and Quere, Paris, "Syndrome of Stilling-Duane-Türck."

The papers presented on May 14th were on the choroid. Babel, Geneva, "The role of the choriocapillaris in degenerative diseases of the posterior pole"; François, Woillez, and Asseman, Lille, "Malignant choroidal tumors of eyes affected with congenital iridic melanosis"; Ten Doesschate and Parren, Utrecht, "Treatment of melanoma of the choroid with a combination of diathermy coagulation and photocoagulation"; Stankovic, Belgrade," Sex-linked familial angiosclerosis of the choroid"; Amalric and Bessou, Albi, "Some aspects of the obliteration of the choroidal network along vascular lines"; Bonnet, Lyon, "What is the semiologic value of granulations visible in the ocular fundus."

"Anatomic study of an iridencleisis performed on an eyeball with malignant tumor of the uvea," Renard, Dhermy, and Mazel, Paris; "Ocular manifestations of the Fiessinger-Leroy-Reiter syndrome," Foucade and Couadau, Oran; "Streptococcic uveitis: Experimental and clinical research," Remky, Munich; "Harada's disease: Chronology and value of ocular symptoms," Larmande and Giudici, Alger.

Papers read on May 15th were: Appelmans and Michiels, Louvain, "The buphthalmic hepatomegalic syndrome"; Hervouet, Nantes, "Enucleation and evisceration"; Baron and Knejev, Nantes, "The utilization of shells of plastic material in surgery of the anterior segment"; Maria, Bonnet, and Cochet, Paris, "Optical and mechanical problems posed by the Strampelli lens"; Rosselet and Stucchi, Lausanne, "Indirect injury and obliteration of retinal veins."

Bouzas, Athens, "Some rare manifestations following the subconjunctival injection of corticosteroids in leprosy"; Dugnani, Milan, "Presentation of two kinds of slitlamps for biomicroscopy and photobiomicroscopy"; Belz, Perdriel, and Guyard, Paris, "Bilateral frostbitten corneas"; Arruga, Barcelona, "Equatorial encirclement for treatment of detached retina"; Bregeat, Juge, Pouliquen, and David, Paris, "Regarding orbito-mesenencephalic angiomastosis"; Thiebaut and Matavulj, Strasbourg, "Ocular symptoms in multiple sclerosis."

Central Illinois Meeting

Dr. George M. Haik, New Orleans, and Dr. John M. Converse, New York, were guest speakers at the recent meeting of the Central Illinois Society of Ophthalmology and Otolaryngology held at the Abraham Lincoln Hotel, Springfield.

Dr. Haik spoke on "The mechanics of intracapsular cataract extraction," "Sympathetic ophthalmia," and "A fornix-conjunctival flap as a substitute for the dissected conjunctival flap." Dr. Converse discussed "Plastic surgery." Dr. George Wyman, Peoria, presented a paper on "Loss of anterior chamber following cataract extraction."

Pakistan Society

On December 19, 1957, the Ophthalmological Society of Pakistan was organized and the following officers were elected: President, Gen. W. A. Burki; vice-presidents, Prof. Ramzan Ali Syed and Prof. Rifat Ullah; secretary, Dr. Raja Mumtaz; treasurer, Dr. M. S. Faridi.

Nassau meeting

Dr. I. D. Okamura, Boston, was guest speaker at the April meeting of the Nassau (County, New York) Ophthalmological Society. The subject of Dr. Okamura's address was "Management of retinal detachment."

Urgent Request

The Uveitis Laboratory, University of California School of Medicine, San Francisco, is interested to obtain freshly enucleated eyes from patients with *all types of uveitis* and other endogenous inflammations. Attempts are being made to isolate etiologic agents from these eyes.

The eyes should *not* be fixed in preservatives or frozen, but placed in a sterile bottle, packaged, and shipped as quickly as possible. Please send specimens air express, special delivery, *collect*. Enclose history and findings and mark the package "Fresh Tissue Specimen—Rush."

A report of isolations of organisms and pathologic findings, including a slide, will be sent to the contributor. Credit will be given in any resulting publications if desired.

• • • •

Telegraph collect if specimen being sent. Send eyes to Samuel Kimura, M.D., Michael J. Hogan, M.D., or Phillips Thygeson, M.D., University of California School of Medicine, San Francisco 22.

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